Popular Science

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July
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In this Issue

5 Big Aviation Features

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Knocks out that "knock"

WHAT IS NEW THIS MONTH

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July, 1928, Vol. 113, No. 1. **Popular Science Monthly** is published monthly at 250 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Chicago, Illinois. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Single copy, 25 cents. Yearly subscriptions to United States, its possessions, and Canada, $3.50; foreign countries, $4. The contents of this magazine must not be reprinted without permission. In presenting in its editorial columns numerous stories of new products of applied science, **Popular Science Monthly** does not underwrite the business methods of the individuals or concerns producing them. The use of **Popular Science Monthly** articles for stock-selling schemes is never authorized. O. H. Caper, President and Treasurer; R. C. Wilson, Vice-President; A. L. Cole, Secretary.

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WHAT IS COMING NEXT MONTH

¶ The night sky glows. Pillars of flame and smoke leap high. The very ground burns. You'll be amazed as you read an eye-witness account of "the biggest fire on earth", which has burned unchecked for forty-four years!

¶ How would you like to speed at thirty miles an hour in your little outboard motorboat? It can be done. An article next month will tell of the astonishing development of small "kickers" into a thrilling new sport. And our Home Workshop expert will divulge secrets of hull and engine design that will help you coax more miles out of every hour.

¶ "Skyscraper" furniture is here. It is the modern furniture which we shall soon see in general use in many homes. Useful and beautiful, it is extremely simple in construction. Any home worker, if he has good designs to follow, can build decorative modern pieces quickly, easily, and inexpensively. Next month, an expert will show you how to do it.

¶ Scattered in far places of the world are rare and wonderful trees that supply woods which are put to curious and often important uses. An explorer whose business it is to search the wilds for these treasures will tell of his adventure.

And fascinating articles telling the latest developments in aviation, answering the questions everybody is asking about airplanes, flyers, and flying

Just What Is an Investment Trust?

By WALLACE AMES, *Financial Editor*

THE question asked in the following letter is in the minds of so many investors that we publish it, and our answer, for the information of all readers of POPULAR SCIENCE MONTHLY.

WALLACE AMES, *Financial Editor,*
POPULAR SCIENCE MONTHLY.
Dear Sir:

I want to invest $2,000 in an investment trust. What little I have learned about them has confused me. There seems to be a great variety of trusts and considerable difference of opinion as to what is the best type. Can you unravel my confusion? *V.D.H., Brooklyn, N. Y.*

The term "investment trust" is used in America purely as a matter of verbal convenience. It applies to a variety of institutions created to offer diversification and other advantages to the investor of small means. Two institutions may each be known as an investment trust and yet be widely different in structure, character and purpose. But the seeming confusion can easily be unraveled and clarified.

In the first place, there are two broad types of investment trust—the general management trust which originated in Great Britain fifty or sixty years ago, and the fixed share trust which is of recent American origin. A considerable number of both types now exist in this country. There are many variations within both of these types which will be better understood if each type is first analyzed separately.

The General Management Trust

THE general management type, strictly speaking, is usually not a trust at all, but a corporation. It is engaged in a business, just like any industry, utility, railroad, bank or insurance company—its business being that of making and managing investments.

This type of investment trust is formed like any other business enterprise. It sells its own stock to secure working capital. It also issues its own bonds (or preferred stock or both) to obtain more capital. It then proceeds to invest this capital in securities.

Ratios vary, but the usual set-up is $2 of bonded capital to $1 of stock capital. Thus there is $3.00 of securities behind each $2 of bonds.

Bonds thus secured can be marketed at a normal interest rate, say 5%. The reason the trust issues bonds is because it can make more on capital thus raised than the bond interest rate. The balance increases the earnings applicable to the stock. If $3,000 invested earned 7% and $2,000 of this amount received only 5% the remaining $1,000 would earn 11%.

The general management investment trust is founded on the principle that any group of securities should be flexible. That is to say, it should be possible to meet changing conditions by selling one security and investing the proceeds in another.

If a change in economic conditions affects the safety of a certain security the general management trust believes that that security should be sold and another purchased which is not so affected. If a security advances in value so that it can be sold at a profit the general management trust believes in having the privilege of taking that profit for the benefit of its shareholders.

THE dividends paid to shareholders in a general investment trust represent but a portion of the total earnings of the trust. The balance is placed in surplus and reinvested. The earned surplus is like a compound interest account. The earnings from original investment are put to work earning more money. Everyone knows how much more rapidly compound interest builds up than simple interest. A growing earned surplus is the forerunner of an extra cash dividend or an increased rate of regular dividends.

The general management type of investment trust makes money on securities in six ways: (1) interest and dividends from bonds and stocks owned; (2) stock dividends declared by companies who are increasing their working capital by the transfer of surplus to the capital account; (3) rights to subscribe to new stock, when issued, at a price below the then market value of the shares; (4) converting bonds into stock, when bonds possess conversion privileges and it is profitable to exercise them; (5) owning bonds which are redeemed before maturity at a premium; (6) profit by selling securities that have advanced in value for more than was originally paid for them.

The Fixed Share Trust

The fixed share type is literally a trust in form. The originators draw up a trust agreement and appoint a bank as trustee. They then purchase securities and deposit them with the trustee. These securities are in groups, or units, with usually the same amount of money invested in each one.

Against each unit participation certificates are issued and sold to investors. The price of a participation certificate is determined by the number issued and the value of the collateral which comprises the unit. Each participation certificate represents its pro rata share in the collateral or deposited security. Thus, with the investment of a small amount of money, an

(Continued on page 5)

An Investment Trust

(Continued from page 4)

investor obtains a share of ownership in many securities instead of whole ownership of any one.

The fixed share type of investment trust issues no bonds or preferred stock of its own. Its only class of shares is the participation certificate all of which share and share alike in the earnings of the trust's investments.

The principle on which the fixed share trust is founded is that investments well chosen in the first place should be held indefinitely on the theory that at least some of the diversified list will show exceptional profits. (Continued on page 6)

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"The Investment Trust from the Investor's Viewpoint," presents an explanation of this form of investment in easily understood terms, illustrated with some interesting examples of how the general investment trust will help the man with $100 or more to get ahead. Published for free distribution by United States Fiscal Corporation, 30 Broadway, New York. Ask them for Booklet IT.

"Ideal Investments" is the designation universally accorded Smith First Mortgage 6½% Bonds which carry attractive tax refund features. A history of the House and information relative to their bonds and the safeguards that surround every issue they offer may be obtained by addressing the home office of The F. H. Smith Company, Smith Building, Washington, D. C.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

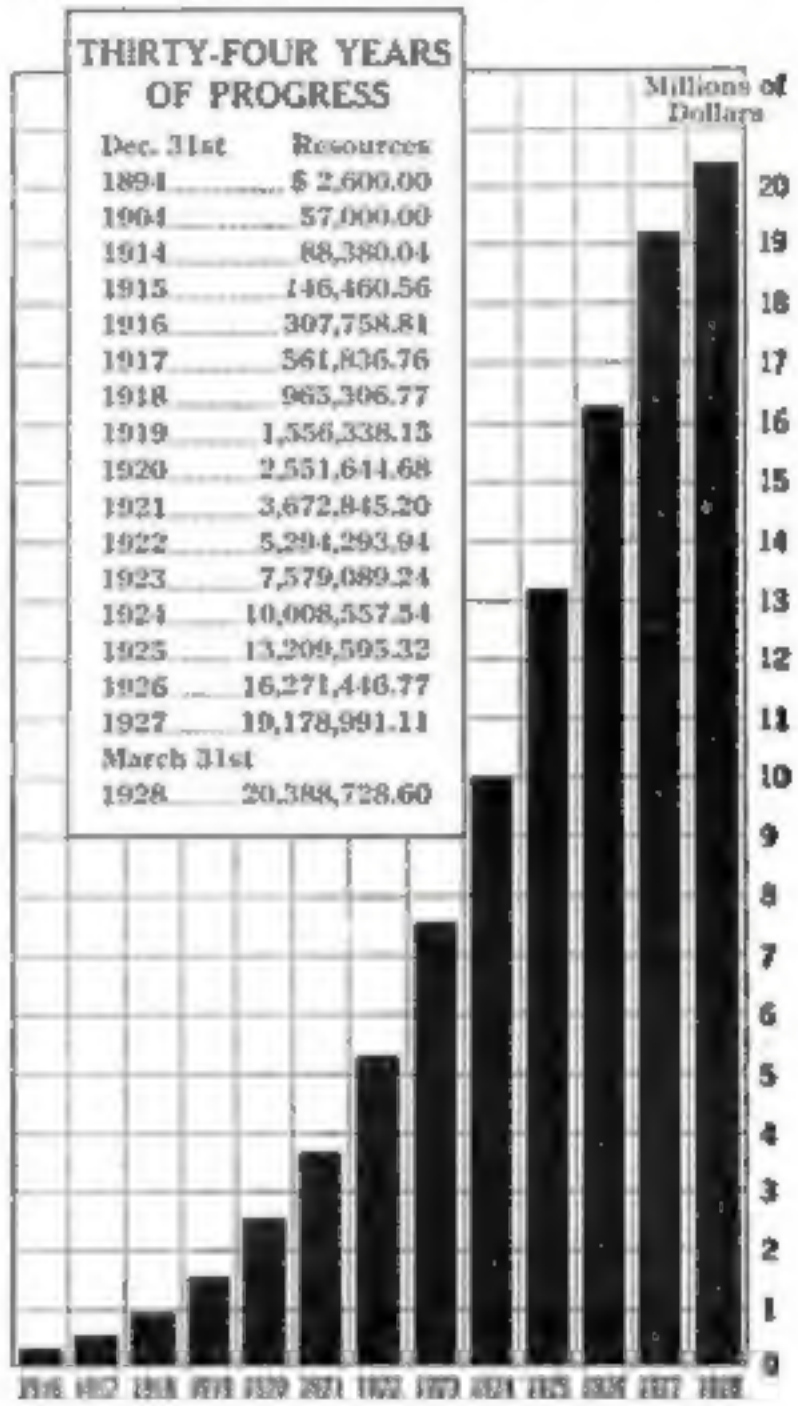
How to Get the Things You Want tells how you can *use* insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

The Guaranteed Way to Financial Independence tells how a definite monthly savings plan will bring you financial independence. Write for this booklet to Investors Syndicate, 100 North Seventh Street, Minneapolis, Minn.

The Making of a Good Investment tells how 6½% can be made on investment in First Mortgage Bonds in units of $50, $100, $250, $500 and $1000; how the bonds are protected and how simple it is to purchase them. For a copy of this booklet address United States Mortgage Bond Company, Limited, Detroit, Michigan.

A Graph of Growth

The chart below is a record of Investors Syndicate's consistent and substantial growth. It is a significant sign of the public's growing appreciation of the value of a definite plan requiring systematic investing.



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THE POWER OF TIME AND MONEY

An Investment Trust

(Continued from page 6)

purchase and management of investments; the fixed share trust a plan for purchase of investments only. Both offer diversification to the small investor, the degree of which depends on the specific plan of the trust.

In the case of the general investment trust the management is restricted in the by-laws as to what securities can be purchased.

Success depends on the care with which these restrictions are drawn plus the facilities and capability of the management.

The earliest investment trusts formed in the United States were adaptations of the British type; the fixed share plan was originated later.

Generally speaking, British trusts are models of sound management as well as examples of high earning power.

Regular annual dividends of 20%, 25% and 30% are commonplace. Because such huge dividends may be depended upon, the shares of old established British investment trusts sell in the open market at four and five times their par value—practically on a basis equivalent to government securities. Investors who bought and held their shares from the beginning have an extremely profitable investment.

ONE of the varying characteristics of American investment trusts of the general management type is in the nature of the management. Some are sponsored and managed by firms engaged in a general investment business—underwriting original issues and dealing in general securities. Others are managed by organizations engaged exclusively in investment trust management.

There is at least a theoretical advantage of the investment trust management organization. It is independent and unbiased in its judgment and selection of securities. It has no interest in one security over another and is guided in its selection only by what it considers to be to the best interests of the trust it manages.

In the general management class there are several forms of capital structure. Some trusts issue common stock and bonds; others also issue preferred shares. In the latter case the common and preferred are usually sold jointly, not separately. Still other trusts issue common and preferred stock, but no bonds. The bonds and preferred shares receive a fixed and limited rate of return; the return on the common is limited only by what is left after bond interest and the preferred dividend is paid.

BOTH the general management and the fixed share type of investment trust have gained immense popularity in America within the past few years. There are probably 250,000 investment trust shareholders in this country; their aggregate holdings of investment trust securities may be in the neighborhood of three-quarters of a billion dollars.

A DIRECT ANSWER TO THE QUESTION

"Which Is the Best?"

Again and again readers ask the same question of The Institute, "Which is the best?"

TO FIND out the truth for the benefit of its readers about products of a technical or semitechnical nature, to determine whether or not such products have evolved from the experimental stage, and to learn which makes are reliable—these were POPULAR SCIENCE MONTHLY'S aims in establishing the Popular Science Institute of Standards four years ago.

It was decided to secure such information by both test and investigation methods, and arrangements were made with New York University for the use of their Sage Research Laboratory in which to conduct such tests. The findings resulting from tests and field investigations supply The Institute with authoritative and impartial information regarding the merits of equipment which, in turn, affords a basis for a service to readers.

This service consists of general information on various types of products supplied through the editorial columns of POPULAR SCIENCE MONTHLY, and specific information on particular makes of products supplied by mail to readers of the magazine at their request. Readers sometimes misunderstand the nature of this service and letters are being received constantly by The Institute asking "Which is the best?" of various makes of products.

Of course, finding out and giving out information as to which products top their field is outside the purpose for which the Popular Science Institute of Standards was established. The Institute is essentially a protective organization rendering a service that will prevent readers of the magazine from buying equipment that will not satisfactorily perform the service for which it is intended.

POPULAR SCIENCE MONTHLY readers have always been interested in the new developments in products of a scientific and semiscientific nature. They are quicker than the average

By
F. G. PRYOR, *Secretary*
Popular Science Institute of Standards

type of individual to install appliances that involve the newest findings and make for better and more modern modes of living. Naturally, there are many products of this type that may render a certain degree of service but are not fully perfected and efficient according to present standards and developments. It is the Popular Science Institute's job to keep up with such standards and developments, to know what represents good value at this particular period, and to separate generally the very good from the mediocre and poor.

For, while there may be no one outstanding product in a class that is superior to all others, there is always a group of good products that form what might be termed the "cream" of their class. A selection from among such products is bound to result in satisfaction. What the Popular Science Institute of Standards does, therefore, is to point out which devices can be considered deserving of classification among this small group when both price and performance are considered. The final choice must necessarily be left to the individual purchaser and made with a view to his requirements and preferences.

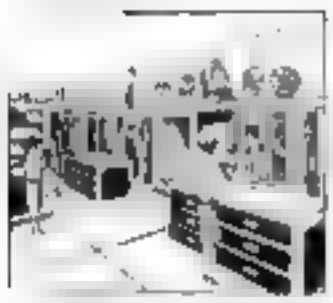
This, we feel, is a very real service, and it is a service that has been taken advantage of by thousands of people who report satisfaction from their purchases of approved equipment. The type of assistance rendered by The Institute is in line with the impartial nature of its organization. The Popular Science Institute of Standards is directed by Dean Collins P. Bliss, of New York University. Products are approved solely on the basis of test and investigation findings and there is no relation whatever between Popular Science Institute's approvals and POPULAR SCIENCE MONTHLY'S advertising contracts. But, without approval, a product cannot be advertised. This means therefore that every refrigerator, oil heater, radio or tool product featured in the advertising columns of the magazine has been found to be up to requirements.

To go further and select one individual product in a group as "*the* best" is something that The Institute has not attempted to do, and would find great difficulty in doing since it would mean carrying tests that are already exhaustive to an extreme comparative point and basing decisions on minute variations in merit. This is something that the Popular Science Institute of Standards sees no need for doing and considers of no real value.

The aid of The Institute in selecting good equipment is free and applies to products in four classifications—radio, tools, oil heating devices, and refrigerators. Address inquiries and requests for lists of approved equipment to the Popular Science Institute, 250 Fourth Ave., New York, N. Y.

Tests of this *grainless* wood show remarkable results in wide range of industries!

Enthusiastic letters of praise coming in every day. Many report new and unique uses. Send for large free sample and find out what Masonite Presdwood will do for you.



FOR STORE FIXTURES

Two years we waited to tell the story of Masonite Presdwood — and two days after our first announcement inquiries began pouring in from every section of the country. Requests for samples already run up into the thousands. And in the meantime, this *grainless* all-wood board has been subjected to hundreds of tests by leading manufacturers in all sorts of industries.

These tests prove conclusively that Masonite Presdwood won't crack, check, split or splinter; that it possesses remarkable workability and uniform strength; that it is very dense and tough, highly resistive to moisture, and takes any finish beautifully. Presdwood also has a very smooth attractive surface on the face side, and requires no paint for protection.

The Story of Fido

Down in Gulfport, Mississippi, Presdwood was recently used in building a speed boat called "Fido". Thanks to this *grainless* wood, the boat when completed weighed only sixty-two pounds, although it is eight feet long and has a forty-eight inch beam.

Knowing that Fido could do better than thirty-one miles an hour over a straightway course, its owner decided to enter it in the Class B Outboard Race in the Gulf Hills Regatta—and Fido won the race!

Better bread boxes

A certain Wisconsin manufacturer, whose name will be given in request, has made some very severe tests with Masonite Presdwood for bread boxes, and reports that it is far better for this purpose than any other material he has ever tried.

In making the tests a large rotating steel cylinder was used, a cylinder equipped with baffle plates, hazards and heavy spikes. The boxes to be tested are put inside of this machine, each box being hurled from one side to another and from one baffle plate to another so that it does not catch the impact in the same place twice in succession.

A box made of the regular conventional material failed under a total of 871 drops. The box made of Masonite Presdwood did not fail until it had withstood a total of 1942 drops!

In a recent letter, Mr. Leo. A. Margola of the Chicago Art Institute writes: "I have been using Presdwood for remounting valuable canvas paintings and for backing and protecting ancient and modern works of art. Before adopting this material, many severe tests proved it to be a safe, durable material, which resists the action of moisture, heat and cold without twisting, wrinkling or warping and with minimum contraction and expansion."

Several railroads are now using Presdwood as paneling in their new Pullman Cars. It is also in wide demand for outdoor and indoor signs, store fixtures, starch trays for candy factories, clothes hampers, radio boxes, cupboards, doll furniture, packing cases.

New uses practically every week

And almost every week we hear of new uses: incubators, barbecue stands, display booths, work-bench tops, bedroom screens, plaques, music cabinets, lining for trunks and wardrobes, theatre props, concrete forms and invalid trays. In addition, Presdwood is now being tested for use by manufacturers of electric equipment, organs, airplanes, clocks, tools, bowling alleys, chemicals, farm wagons, trucks, automobiles, iceless refrigerators and church furniture!

Masonite Presdwood may be exactly the material you are looking for. Write for large, free sample. It will be sent promptly on request without placing you under any obligation.

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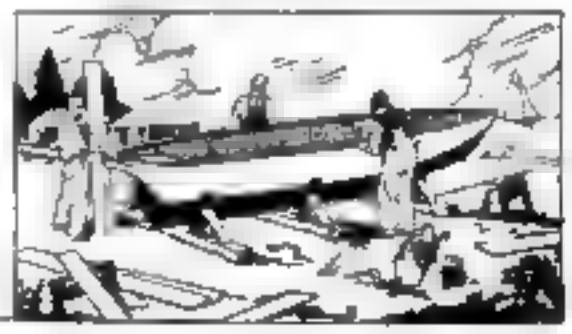


Our Readers Say—

How Many Are a Few?

"I THOUGHT you had enough judgment not to let the present aviation craze run away with you. It appears I was mistaken. Encouraging young people to make careers of flying, as you do in 'Breaking into Aviation,' is bound to cause much harm, even though you warn that flying offers no easy road to fortune. On the cover you say, 'Pilots tell how you can break into a union,' giving the impression that there's a future in the game for almost anybody. The truth is, though, that only exceptional persons, constitutionally built for flying, can hope to succeed. You're simply basking to disappointment, and future youths who might have brilliant careers in other lines. Aviation is a game for a few.—A. N. P., Detroit, Mich.

From Future Flyers

"JUST a line to let you know how much I appreciate your efforts to make the young people of America air minded. I can see that the coming field will be aviation, and I expect to get into the game as soon as possible. I am doing all I can now to educate myself along this line by building and flying model airplanes. I have profited much in the last year by the airplane model articles in POPULAR SCIENCE MONTHLY, having recently designed and built a cabin-type monoplane with a wing spread of thirty-six inches. I belong to two model airplane clubs, and am president of one. Keep up the good work."—W. L. D., Cleveland, O.

"Mr. Wheeler's article, 'Young America Finds Its Wings,' in your May issue, was the best article I've ever read about model airplanes. I was particularly interested in Eddie Marcouiller and his neat little idea of launching a parachute from a model airplane. I am a boy but am very enthusiastic about aviation.—J. D., Yonkers, N. Y.

Radio Editor: Can You Fix?

"HAVING built the one-tube set from your blueprint, my only objection to it is that I don't get to bed as early as I should.—C. T. M., Gem, Idaho.

"I have just built the wave trap described in your April issue, and find it works better than anything I have been able to make or buy. I live close to two high-powered broadcasting stations, and never had been able to cut them out before. I am quite a bookworm, but there is no book that can come up to POPULAR SCIENCE MONTHLY."—H. C. S., Oakland, Calif.

"I received the blueprint and built the four-tube set and have it going. I sure can get stations by the dozen, and all come in fine. One of my neighbors said she liked it as well as her $140 receiver."—H. N., Crowell, Mich.

Yes, You're Right

"A FRIEND and I engaged in an argument. He said it was the weight of the car that keeps a railroad car on the track. But I said it was the flanges to be found on the inner sides of all railroad car wheels. Projecting below the running surfaces of the wheels, they keep a car from slipping sideways. I notice that when a train goes around a curve there is always a shrieking noise caused by the pull of the flanges on the wheels on the side toward which the turn is being made. And I contended that the flange was invented about 1818 for mule-drawn cars in coal mines. Am I correct or is my friend?—J. A. S., Jr., Topeka, Kas.

Fool and Hero, Both

"WHEN A. L. M., in his letter, objects to Fitzhugh Green's story of Dick Byrd because it tries to turn foolhardy into heroism, does he recall that Columbus was a fool when he drove his tiny ships westward until he touched a wild island off North America? His very foolhardiness opened a New World and changed history. Just so the foolhardiness of Byrd, Lindbergh, Chamberlin, the *Bremen* flyers, and others is again opening a new world in which the farthest lands and nations no longer can be isolated or separated by the great waters. Fool or Hero? Byrd is both.—P. R. Z., Nashville, Tenn.

You Can't Fool a Puzzler!

"FIVE of us puzzlers met at lunch today, and the opinion was unanimous that Mr. Armagnac made a good job of his article about the convention of the National Puzzlers League. The illustration was good; I could recognize everyone in it. The magazine I find very interesting and attractive."—A. H. H.—pseudonym "Atha"—Baltimore, Md.

Page Sir Jagadis

"THERE is probably something I don't understand about the plant experiments of Sir Jagadis Bose, the Hindu naturalist, as told in your April issue. He used an electric probe to detect pulsations in the cells of plants by pulsations in the electric current. Now if he will put that probe into any moist substance, dead or alive—water, milk, wine or meat—he will get a muscle current, even if the electrodes are both carbon, or platinum. I've tried it."—E. P. T., New York City.

How About Prohibition?

"MAY I suggest to J. E. N., who complains that with all his wide knowledge he can't interest anybody with his talk, that he has made at least three fatal errors. He has neglected golf. He has neglected bridge. He has neglected women. These are really the only three fields of brilliant conversation.

"The easiest talker I know is a salesman who thinks that Dr. Eliot wrote 'Silas Marner' and that logarithms are prehistoric monsters.

"Slide rules and fossils! J. E. N., you're hopeless."—P. A., Philadelphia, Pa.

The Same Little Book

"HAVE there been any changes made in the 'Pocket Guide to Science'? I carry mine with me always, and it has settled many an argument for me.—H. F. K., Minneapolis.

That Would Be the Limit

"I MUST say that you have taken a backward step in introducing fiction. I felt real bad when you announced your new policy, for I was proud of your magazine, but now I shall not be surprised if I find a pretty girl on the cover. Ugh! 'If It Could Talk.' Sask., Can.

My opinion is that your fiction is a great improvement. 'The Make Must Go On' came very opportunely, just as I was dealing with coal gas and water gas in my general science class, and I did not hesitate to recommend the article to my pupils as a great help to their understanding the process. This type of fiction is very good. Keep it up."—Rev. A. J. H., St. Peter's College, Muenster, Sask., Can.

Can the Earth Explode?

"RICHARD ALDEN SWALLOW'S article on 'How the World Will End' does not altogether agree with fact, in my opinion.

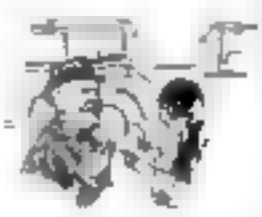
I believe the earth will never explode from within, as long as it is in constant motion. The atmospheric pressure is sufficient from without to hold any pressure from heat or ghost from within.—A. I., Stockton, Calif.

Chewing as They Choose

I SEE you have taken notice that Stefansson, the explorer, has gone on a straight meat diet to fool the diet sharps. On the other hand, there is J. C. of Toledo. He says in his letter which you printed in the May issue that he has lived on a vegetarian diet for many years and is in perfect health. My old grandfather eats (and drinks) what he chooses, and is merry. So there you are. 'What Doctors Don't Know about Diet' has caused more talk around here than any article you have published."—D. B. C., Chicago, Ill.

Why Argue with a Woman?

"IN YOUR April issue D. B. M. takes a fling at women drivers. As a woman driver with fourteen years experience under all kinds of conditions, I feel his statements should not go unchallenged. D. B. M. continues to live in the dark ages when women were the slaves of men. I'd be willing to risk a competitive intelligence test with him any day or an automobile test.



"In my years of driving I have witnessed several accidents and read of many more, and men have been involved in all of them. Statistics in Massachusetts prove that women drivers have fewer accidents than men.

"D. B. M. tells of the woman driver, with front wheels on the track, and an engine coming, 'fishing for a compact.' He makes an example of an exception. How about the man who reaches for a flask and crashes into another car?"—(Mrs.) F. D. R. B., Springfield, Mass.

Don't forget to make your letters direct and to the point. For obvious reasons we cannot publish letters of more than two hundred words.

Popular Science MONTHLY

JULY, 1928 SUMNER BLOSSOM *Editor* VOL. 113, NO. 1

Super-Rays Reveal Secret of Creation

A FAMOUS Adventurer in Science Tells How He Found Streams of Energy a Thousand Times More Powerful Than X-Rays, Coming from Beyond the Stars — What He Learned of Their Meaning

By ALDEN P. ARMAGNAC

A STOCKY, white-haired man spoke from the platform of the gray-domed National Academy of Sciences Building at Washington the other night. Row upon row of the nation's most distinguished scientists burst time and again into applause. He was Dr Robert Andrews Millikan, winner of a Nobel prize for physics, and of the Edison Medal. He was telling of the crowning achievement of his amazing adventures in science — of his newest discoveries about the mysterious "cosmic rays" which pour upon the earth from outer space.

Ever since these strange rays of "invisible light" were first definitely recorded by Dr Millikan in 1925, scientists have been working feverishly to learn what they are and whence they come. They are the most powerful known, more penetrating than X-rays or radium. Once harnessed, they may mean more to the world than any of the other wonderful forms of radiation, visible and invisible, which today are applied to countless uses. What is their secret?

To the scientists, Doctor Millikan answered,

"These rays are the invisible messengers of creation!"

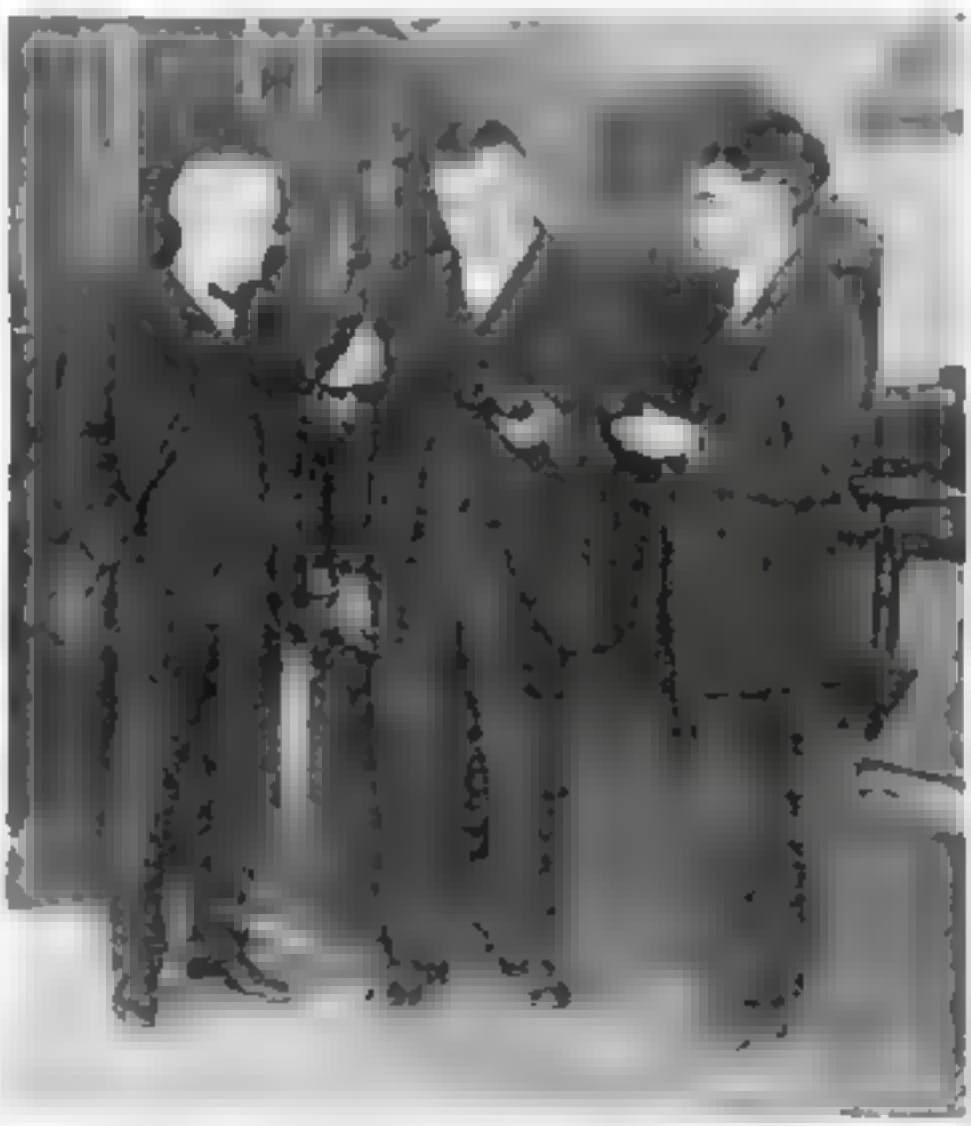
Creation, he said, is still going on — not merely the creation of new worlds or of living things that people them, but the birth of the very particles of substance from which rocks and animals alike are made. His study of the cosmic rays, he added, revealed the first direct, indisputable evidence that beyond the stars, perhaps even on earth, too, four of the universal simple substances are daily being born from hydrogen and helium gas. These substances are oxygen, the life-giving gas, magnesium, whose burning light makes night photographs possible; silicon, of which the earth, glass and sand are largely made; and iron. And the mysterious rays from afar, possibly from the great spiral nebulae that astronomers know as half formed universes in the making, are simply energy hurled forth from the atoms in the mighty travail of new creation.

In other words, the rays are messengers telling us that the universe isn't running down. Rather it is being built up and replenished by continual creation of its common substances from the two simplest substances of all, two gases that are extraordinarily abundant throughout the stellar world!

To scientists Doctor Millikan's announcement of this transmutation, or change, of the elements is nothing less than astounding. Never before have simple elements been known to change into higher ones. Dr Millikan's discovery would have been not one whit more astonishing if he had seen silver turning into gold!

But to the layman greatest interest is found in speculations as to the value of these rays of his to the world. When X-rays, radium rays, ultra-violet rays, and radio waves first were discovered, they were considered plaything of scientists. Today they have revolutionized the daily life of men. Just so, these new "cosmic rays" promise eventually to reshape the very fabric of human existence.

Think of what our life would be today without radio, with-



Dr Millikan (left) and assistants, Melvin Pearson (center) and I. S. Bowen, holding the balloon instruments that recorded the cosmic rays

out the innumerable applications of ultra-violet rays, X-rays, radium rays in giving us health, profit, conveniences and pleasure. Then let your imagination wander on the possibilities that may result from this one discovery of cosmic rays—the rays of creation itself!

Powerful? They can go through a wall of lead twenty feet thick like light through window glass. A battleship's armor plate is like a sieve to them. They are everywhere. As you read they are entering your own body, as they enter mine as I write—beating down on all the world with one tenth the force of the entire heat and light the world receives from sun and stars.

On mountain summits they are three times stronger than at sea level. Yet they are among the most elusive things known to man. It would take a billionth part of their waves to equal in distance the thickness of a cigarette paper. They resemble X-rays, but are a thousand times more penetrating.

From the lips of Dr. Millikan in Washington, I heard the thrilling story of his discovery. I found him a vital, dynamic man of sixty, whose handshake crushed my fingers and whose simple words carried the assurance of authority. That story was one of years of fruitless experiment, bitter disappointment, physical hardship, and final triumph. He told of struggles up rugged mountains on two continents to find and measure the elusive rays—then of a flash of inspiration only a few weeks ago that proved the rays the actual messengers of creation.

Born in Morrison, Ill., the son of a minister, he had studied at Oberlin University in preparation for his Ph.D. at Columbia University. Prof. Michael I. Pupin advised him to study in Germany and on his return from the universities of Berlin and Göttingen he taught physics at Oberlin and at the University of Chicago, before becoming director of the Norman Bridge Laboratory of the California Institute of Technology.

Then he startled the world by pulling loose from the rest of matter for inspection the inconceivably small electron—the first time it had ever been isolated. For this he received the Nobel prize in physics for 1923—and an electric shock that nearly cost his life. From the apparatus used in the test he took an accidental jolt of 5,000 volts. "It should have killed me," Dr. Millikan said as he exhibited its white scars on his thumbs, "but it didn't!"

It was in 1910 that Millikan, then professor of physics at the University of Chicago, read that a German, Dr. A. Gockel, several thousand feet up in a balloon, had found rays streaming through the air—very short, rapidly-vibrating rays like those of radium or X-rays, for those alone could affect his electroscope, or detecting instrument.

Where could they come from? Scientists knew many kinds of rays, visible and invisible, ranging in a series, each having a different wave length. At one extreme were rays of the longest wave length, which give us radio. At the other, perhaps, were these new rays, whose waves differed from those of radio as a ripple in a bathtub differs from an ocean's surge. In between were heat rays, visible light rays, X-rays, radium rays, and so on. But these new rays apparently were shorter and therefore more penetrating even than those of radium. Millikan knew that radium rays, plentiful at the earth's surface, couldn't penetrate that high. Could there be other rays, like radium's, piercing down from above? A fascinating possibility!

If the rays came from outside, Millikan reasoned, they should be hundreds of times stronger at the top of the earth's air than at the bottom. He resolved to send a sounding balloon with instruments to record them clear to the top of the atmosphere.

Dr. Millikan (left) and Dr. G. Harvey Cameron with electroscopes they sank in California and Bolivia mountain lakes to detect cosmic rays. The instruments were raised and examined through the eyepiece

The war intervened, but in 1922 Millikan and his assistant, Dr. I. S. Bowen, sent up from Kelly Flying Field, at San Antonio, Texas, a set of small balloons with diminutive electroscopes.

Helpful Texans found and returned three balloons. One had gone ten miles high—ninety-two percent of the way to the top of the air.

"You can imagine our surprise—and disappointment," Millikan said, "when the electroscope showed only a meager record of rays at the top of the air, scarcely more than far below. Certainly they were not hundreds of times stronger at the top. It proved we were completely on the wrong track!"

In order words, the cosmic rays, if they existed, must be so penetrating that only slight variation in their intensity could be detected even after passing all the way through the earth's thick blanket of air.

How, then, could they be recorded? How could he measure them or discover their nature? There was just one way, Millikan decided. That was to build a wall so thick that it would stop radium rays, the most penetrating known; then to find whether there existed any more powerful rays which could go through that wall. If traces of such rays were found, then he would build the wall still thicker, until it would stop the cosmic rays, too. That would give a measurement of their power.

So Dr. Millikan and Dr. Russell Otis, an assistant, went to the top of 14,000-foot Pike's Peak, and there laboriously constructed a lead wall. They thought they found signs of the cosmic rays, but they could not be sure. For, as they subsequently learned, the rays were so penetrating that their wall could not trap them no matter how thick they built it! It was like trying to catch a slippery minnow with a wide-mesh shark net. The experiment was a failure. Two years of work apparently wasted.

"Then," said Millikan, "we saw what fools we had been to carry building materials up that mountain. Why build a wall when you can bury an electroscope in the bottom of a mountain lake just as easily as you can hide it behind a lead screen, and the water of the lake will serve as the equivalent of many feet of lead. The next thing to do was to go at it sensibly. We would climb to the top of 15,000-foot Mount Whitney, in southern California—the highest mountain in the United States—and there, under its brow, would sink our electroscopes in the pure, snow-fed waters of Muir Lake."

With Dr. Cameron and a couple of students, Millikan toiled up Mount Whitney in August, 1925, and found the secret of the stars.

Two thousand feet from the top, they had to shoulder the boats, lumber to build rafts, and instruments their mules had carried.

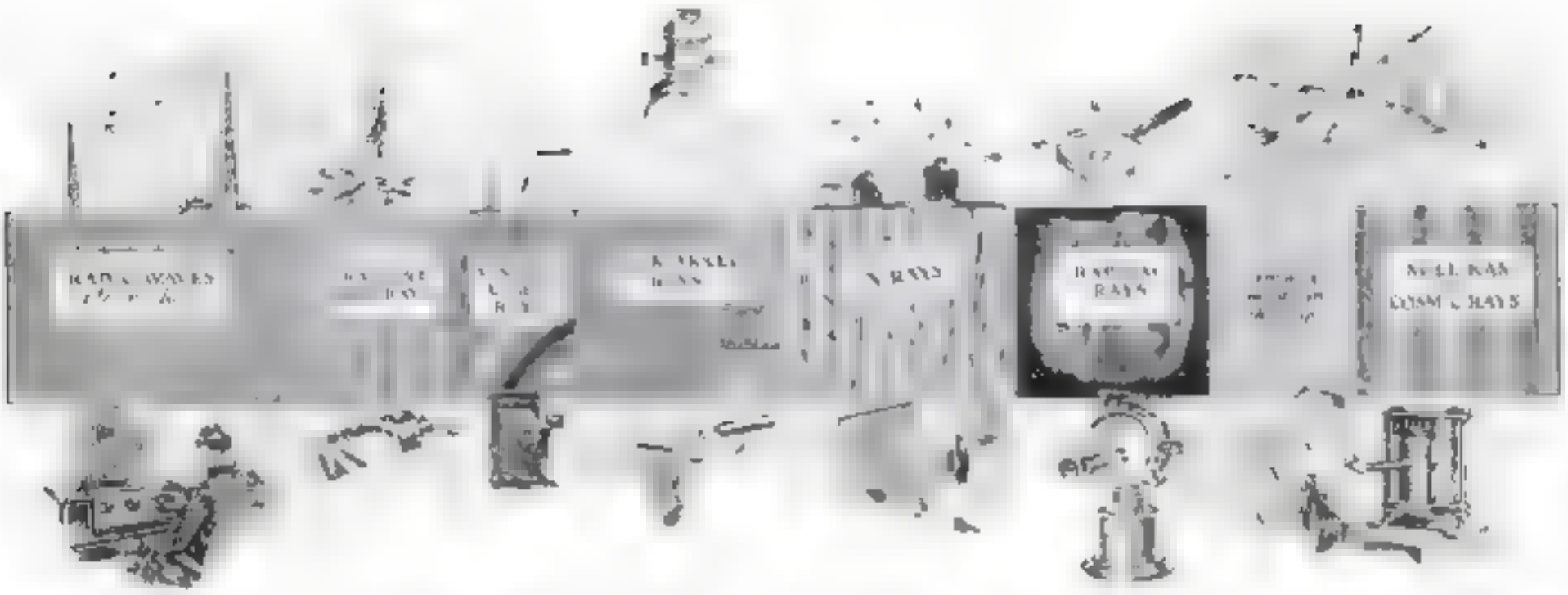
Anxiously they sank their electroscopes. A cry of triumph echoed through the frosty air. There were cosmic rays—rays that pierced the water for fifty feet, downward, and then stopped!

They had gone through water equivalent to six feet of lead. Where did they come from? The stars?

Perhaps not. Perhaps, as some critics hastened to suggest, the air was full of radioactive dust of extraordinary radiating power. In an ingenious way Millikan silenced them. At Arrowhead Lake, 300 miles to the south, he repeated his tests. If the rays came from beyond the earth, they would now have to pierce, first, a layer of atmosphere equivalent to six imaginary feet of extra water—for Arrowhead Lake is 6,700 feet lower in altitude than Muir Lake. Hence, if the rays really came from the heavens—electroscopes a foot deep in Arrowhead Lake should give exactly the same readings as one plus six, that is, seven feet, in Muir Lake. If they came merely from the air, the altitude would make no difference.

"That was the prettiest observing we'd done thus far," Dr. Millikan said. "In Arrowhead Lake we found exactly six feet difference in readings, taken all the way from the surface down!" That settled it. They were dealing with cosmic rays—rays from beyond the earth.

From then on, the story moves to a swift climax. To find the source of the sensational new rays, Dr. Millikan and Dr. Cameron went to Bolivia and on a mountain detected cosmic rays by day



Here are all the other waves we know visible and invisible new and old, arranged in series from the longest radio waves, to the short newly discovered Millikan rays, with illustrations showing how they are produced and detected. So far cosmic rays have not been put to work but scientists believe time may prove them more useful than all the others

and by night; that ruled out the sun as their source. With the Milky Way overhead and without it, too, the rays were the same. Apparently they came from every direction of the heavens equally strong.

Any possibility other than that his rays were cosmic, Millikan answered with one retort. Wherever he had measured them at the same altitude in California, Bolivia, and Panama—they were the same, unvarying by a hair's breadth.

After his return from Bolivia, Millikan spent the whole winter improving his technique, preparing to measure the rays with greater precision. Now he had new electroscopes ten times more sensitive. Last summer he and Cameron went to two California lakes—Gem and Arrowhead—and detected rays as far as two hundred feet beneath the surface. They could have penetrated eighteen feet of lead.

Several slightly different rays they found, and, by measuring their penetration, were able for the first time to give them their correct place in our list of known rays. They proved to be a hundred times shorter than the rays produced by the most powerful changes within atoms heretofore known—radium rays! That accounted for their ability to penetrate lead—they could squirm between its very atoms. These are the shortest, highest-frequency radiations ever discovered.

The scientific world demanded to know where these rays came from—how they were born. Millikan didn't know.

One Saturday night only a few weeks ago, when he was going over his figures with Dr. Cameron, an inspiration flashed across his mind. Only one thing could produce rays of such power—the complete, bodily change of an element, such as hydrogen, or perhaps its neighbor helium, into more complex elements like silicon and iron. That would happen in a flash of celestial energy that would loose rays, and through a formula that Einstein first worked out they could calculate the power of such rays.

Feverishly the two men set about computing the strength of the ray that hydrogen changing into helium would loose. "Penetrating power, .32," they found. Millikan compared it with a cosmic ray they had actually observed. "Penetrating power"—or "absorption coefficient," as Millikan termed it—".35." Unmistakably the same, allowing for slight experimental errors! Just as closely did other cosmic rays that Millikan had observed compare with the birth of other elements.

"Now it all seems so confoundedly simple," Dr. Millikan said, "I cannot see how we failed to realize before that the elements were really changing and causing these cosmic rays we had pursued over two continents."

On one point I was still not clear. Whence came the rays in these transformations? Dr. Millikan explained, simply, how they were the left-overs, the waste, of the process. Suppose hydrogen turns into helium. A helium atom is almost four times as heavy as one of hydrogen. It takes four hydrogen atoms to make one of helium, and, like the proverbial apple of our grammar school days, there's a fraction of a hydrogen atom left over. What becomes of it? It turns *into energy*, Dr. Millikan says—and that energy, reaching the earth in the form of radiation, is the cosmic ray.

This happens, probably, in the nebulous worlds of the heavens; but it may happen on earth, too, Dr. Millikan conjectures. "It is interesting that helium is found in wells along with natural gases that might conceivably have evolved from it.

"There is no force of the laboratory gigantic enough to duplicate this process of creation," Dr. Millikan said, "but it is quite possible that some day doctors may treat patients with cosmic rays, and it is not unlikely that everyone on earth is influenced by them to some extent."

Who can predict what the future world, knowing at least how to control and admit cosmic rays at will, will learn to do with them?

Beyond the Boundary

¶ In the center of an eighty-acre pasture, a bug crawls to the tip of a blade of grass and peers around. Then he calls to his mate below:

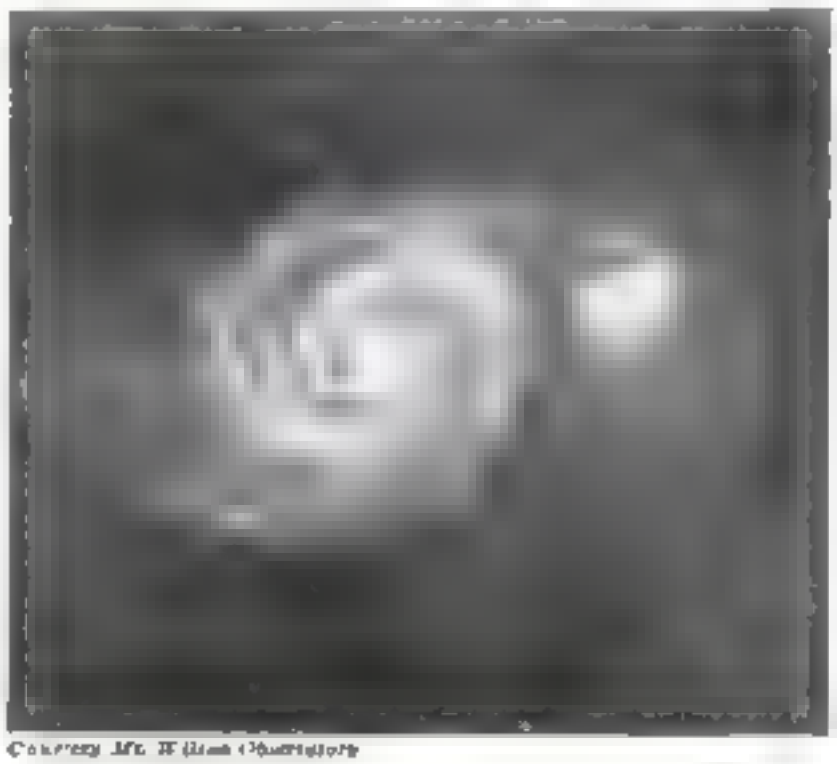
¶ "From up here I can see to the ends of the universe! It extends just ten grass blades in each direction."

¶ That is as far as he can see. But beyond his sight are stretching blades billions in number.

¶ Similarly, on our little blade of grass, the earth, we peer into the sky and are sometimes tempted to say certain stars mark the boundaries of the universe.

¶ But here is an adventure story of a man who thought beyond such boundaries and followed an idea through snowstorms and Bolivian jungles to a discovery of wonderful rays.

¶ It will lift you out of everyday commonplaces and leave you standing in awe before the vast forces beyond the stars.



Courtesy Mt. Wilson Observatory

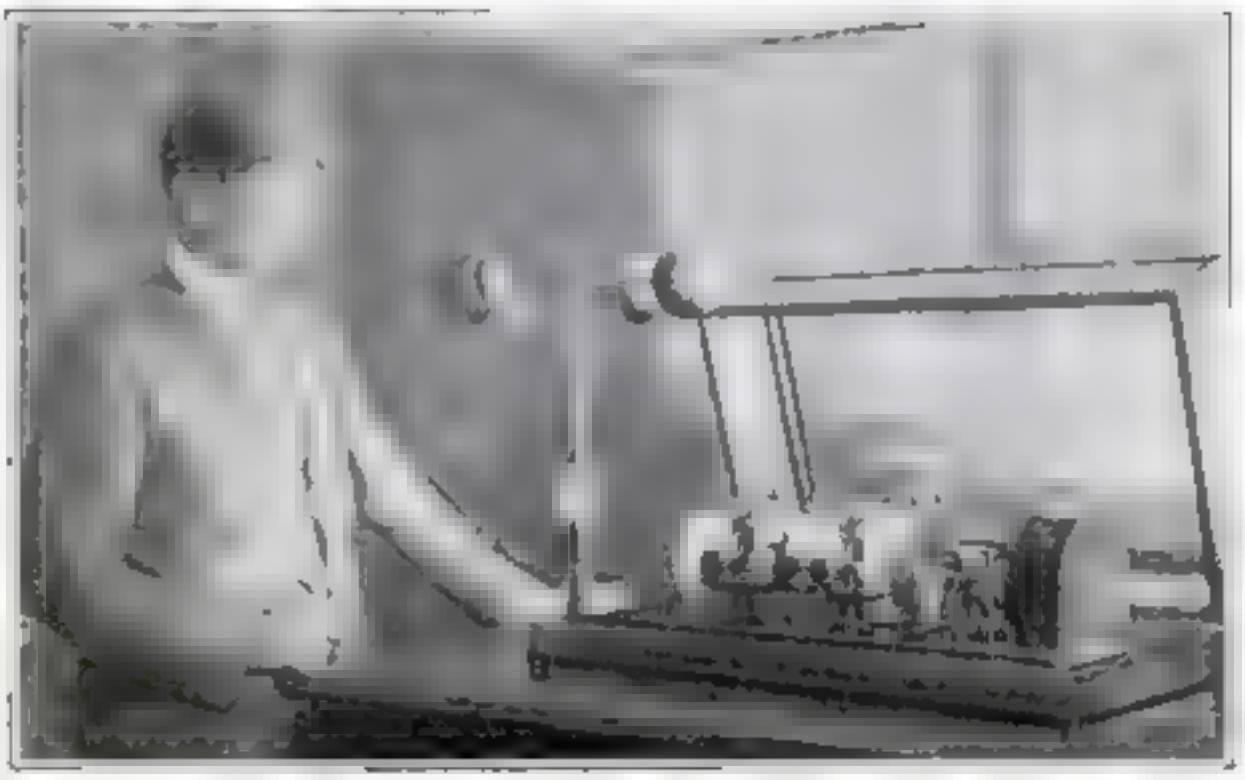
One of the birthplaces of cosmic rays, according to the Millikan theory—spiral nebula Canes Venatici, photographed with 60-inch reflector. In other nebula and elsewhere rays may be born

Telling *Ocean Flyers* when *to* Hop

The Man Who Said "Go!" Reveals How Pilots Risked Their All on His Ability to Forecast Atlantic Weather

By JAMES H. KIMBALL

Associate Meteorologist, U. S. Weather Bureau, New York City



Reading the meteorograph atop a skyscraper that helps provide the data for weather forecasts for ocean flyers. The machine constantly records barometric pressure, wind, rain, and other details of meteorological importance to the weather man. At the left is the anemometer or wind gage which measures the speed of the wind

THE perils and hardships encountered by the crew of the *Bremen* in their successful flight from Ireland to America have not dulled the desire of other European airmen to make the attempt. As I write, more than a dozen of them, with one eye on the weather, are restlessly waiting to hop off.

Far out over the Atlantic buffeting storms, freezing clouds, and blanketing fogs also wait. Unless these are located and charted, the brave airmen must "fly blind" into whatever unknown dangers beset their paths. An accurate knowledge of these destructive forces may spell the difference between success and disaster.

In the memorable flying season of Lindbergh, Byrd, and Chamberlin, a year ago, I was the "official dispatcher." We knew the weather. We had plotted the storms and charted the winds. We mapped the treacherous air routes and, to their hangars, flashed the final word "*Go!*"

Coöperation between meteorological stations located in the United States and Europe, aided by the reports of ships in the steamer lanes, would give to the east-to-west flyers similar information, and remove one of the last elements of chance from trans-Atlantic flying.

As planes are made today, they must have exactly right weather to fly the Atlantic. Before we give the word to go, we demand two conditions:

First—a wind from the west, to help get the heavily loaded ship off the ground, and to push it along once it is in the air.

Second—reasonably settled weather over the ocean, and the absence of destructive storms.

The planes of today structurally may be able to fight their way through minor storms, but they cannot carry enough gasoline to drive them through adverse winds over 3,000 miles of ocean.

OUR ancestors flattened themselves on the limbs of trees and watched the woolly mammoth and the saber-toothed tiger pass below. They trembled as they watched. But they also thought as they studied the beasts. They learned their habits and weaknesses. They learned where to lay snares and to dig pits; when to drive home the spear. By observing their foes, they conquered them.

Today we are observing and studying another of man's ancient enemies. This is the weather—the blizzard, whirlwind, storm at sea. Mr. Kimball tells here how we have advanced in understanding its whims and habits.

William C. Haines, a Weather Bureau meteorologist, chosen to accompany Byrd on his Antarctic flight, gaging the height of clouds with a theodolite

The Europeans' east-to-west flight this spring recalled to me the hectic days when our flyers determined to make the west-to-east flight. Their eagerness pervaded the ordinary calm of the Weather Bureau office atop a skyscraper overlooking the Battery in New York City.

For weeks we have studied the storms. Ships at sea and meteorological stations on land are reporting to us by wire and radio twice daily—barometric pressure, movements of winds, temperatures of land and water, type and action of the clouds. On our maps and charts we plot the maneuvers of the storms and the shifting directions of the winds.

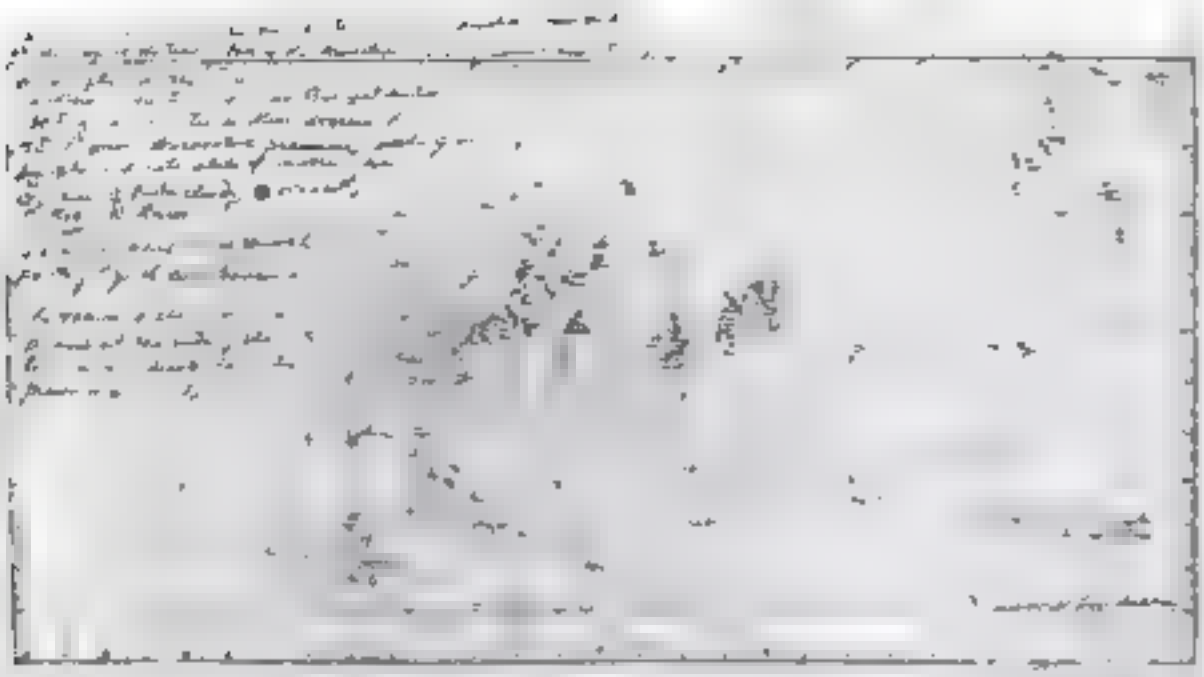
NOW comes a day when they are leaving the path the flyers must take. The winds are veering to the east. Planes and pilots wait the word. And the word is near. Eleventh hour reports from ships at sea. Again we scan the charts. Tomorrow! A phone call direct to the flying field—"*Go!*"

We had been watching the Atlantic for Commander Byrd and the pilots of the *Columbia* for days when Major Davidson, the flying operations officer at Mitchel Field, walked into our office and said:

"A young fellow named Lindbergh has just arrived from out West. He has no organization or equipment, but he says he's going to Paris! Will you keep him informed on the weather?"

That was the first we had heard of Lindbergh. We sent him copies of the maps and charts. He got the first just four days before he actually took off. I shall never forget that day!

As we plotted the charts the morning before our hopes were rising. Back inland we saw barometer readings of 29.60 and a storm area over Ohio, Pennsylvania, and West Virginia. There was an area of "high" over Ontario, between Lake Superior and Hudson Bay. There the barometer read 30.10 and generally fair weather prevailed.



The map that Meteorologist Kimball sent Lindbergh indicating probable favorable weather just before the flyer took off for Paris. The Colonel later returned the chart to the author after he had noted on it the actual weather conditions encountered at the various points

From the Italian steamship *Conte Biancamano* in latitude 63.70, longitude 41.30—not far off the coast—came an encouraging report. Air temperature, 02; barometer, 29.78; wind, northeast. Ships farther out were reporting. The *Baltic*, at latitude 44.10, longitude 43.70, radioed a temperature of 04, barometer of 30.33, visibility good, wind northwest. The *Annandale*, *Minnesota*, and *Steel Exporter*, between the *Baltic* and European ports, sent favorable observations.

The meteorological station at Cape Race, Newfoundland, reported a temperature of 42 degrees, a barometer of 30.02, and a six-mile north wind. We plotted a storm area extending over the Azores, with a barometric reading of 29.98 and an area of "high," good weather extending from longitude 24.90 to longitude 10, and from lat tudes 40.10 to 36.00.

That evening more and detailed reports came from sea. The wind was shifting to the east—it would be at his back! There were no storms over the Great Circle course. There would be clouds and some fog, but he could get through. A storm was charted to the north of Newfoundland. But it wouldn't bother him if he flew soon.

I GOT Lindbergh on the telephone at the field. "You can go in the morning!" His voice, happy and confident, came back, "That sounds good to me. I m on my way!"

As we had expected, the storm over Newfoundland gave him a heavy local rain, but he got through and the rest was comparatively clear sailing. He had a 15-mile wind on his tail throughout the whole course. That's what he wanted.

But back of our "Go" signal was an ocean-wide system for the collection of accurate data on winds and storms. There could be no guesswork when brave men were gambling with their lives.

The conditions I have described as essential for the Atlantic flyer—a helping wind at his back and the absence of storms on his course—come only with an area of high barometer to the south of his course, and an area of low to the north. We forecast those conditions from twelve to twenty-four hours in advance to give the flyers time to make ready. The final word "Go"—flashed perhaps in the middle of the night—was withheld until the eleventh hour of checking the latest reports.

After Lindbergh's triumph there was some ill-advised talk because Commander Byrd insisted upon waiting for favorable weather. Lindy had taken a chance, the public argued, so why shouldn't Byrd?

We realized the Navy commander's eagerness to be off at the first possible chance, but the day before his departure the weather seemed impossible. A steamship off the Newfoundland coast had reported a low and falling barometer—most unfavorable. But two land stations on either side of it reported conditions were right for Byrd to hop off! Clearly an error had been made by somebody, but we could not tell Byrd to start while that error existed.

That night later reports began coming in from the ships at sea. We checked our charts again and again and it was almost midnight when I discovered the error. The ship that had reported low barometer was wrong by unanimous reports from other vessels in that locality. The next day would dawn right for Byrd!

At the house where he was staying, near the flying field, the Commander had gone to bed, believing departure within another twenty-four hours out of the question, but I persisted in my telephoning until I got his brother Tom and told him the news. Commander Byrd got Acosta and Noville and Balchen out of bed, and the *America* was off.

The wind was twenty-five miles an hour at Byrd's back the greater part of his way across. We knew he would have clouds and fog, for they invariably are associated with favoring westerly winds. But Byrd knew his navigation and his instruments—he was in the clouds for eighteen hours, and he came out of them precisely where he had expected.

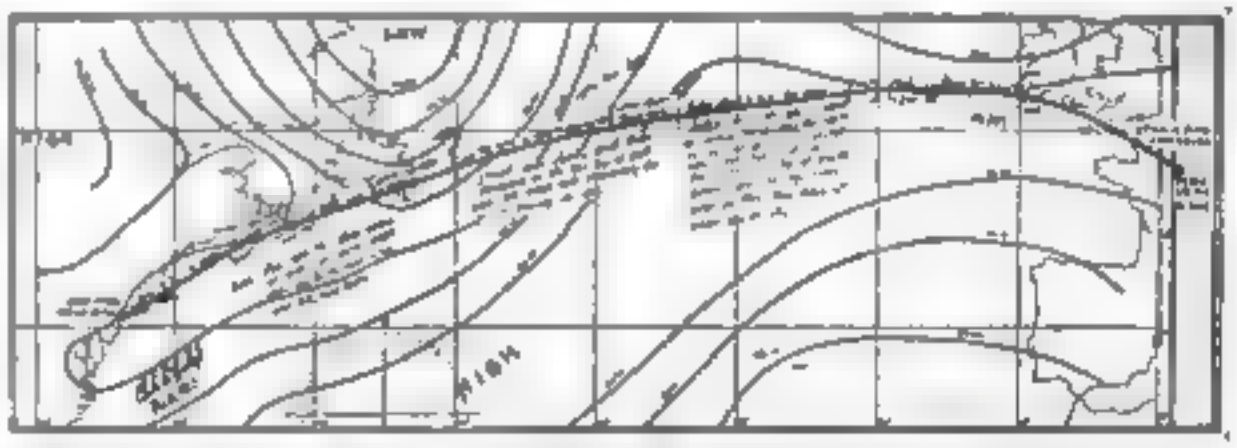
During those anxious days and weeks of plotting the courses of the brave flyers, I came to know them well. I rejoiced in their triumphs and grieved when disaster befell them. I cannot forget that last meeting with Hill and Bertaud, of the ill-fated *Old Glory*, which set out for Rome. They stood with me and Philip Payne, their passenger, in the Weather Bureau while Hill traced on the globe the path that led to the grave.

We started *Old Glory* when the following winds were favorable. The only storm center was well to the north of her course.

Nor can I forget that brave woman, Mrs. Frances Grayson, who flew to her death in the *Dawn*. We had ceased our service for transoceanic aviation on October 10 as the end of the Atlantic flying season, but Mrs. Grayson was determined to go even after that.

I did my best to discourage her. The winter storms over her course, I told her, made her plan almost suicide. Day after day I showed her the weather charts for years back, to (Continued on page 130)

James H. Kimball, meteorologist who has acted as starter in west-to-east trans-Atlantic flights by advising the aviators as to the probable weather they would encounter over the mid-Atlantic



Colonel Lindbergh's chart of his New York to Paris flight, showing how closely the conditions he met agreed with the Weather Bureau expectations, based on data from weather stations and ships at sea

"HUNKY"

By
WHITMAN CHAMBERS
Illustrated by O. F. Schmidt

Hunky had hired on as a bankman. How he had drifted into that fever-ridden section of South America, no one knew

FROM South American Jungles Comes This Remarkable Tale of Men Who Risk Lives in Raging Flood for Rare Platinum Grains

THEY called him "Hunky." Just why I never knew. But he was Hunky on the pay roll and Hunky to the crew of the Consolidated's Number Four dredger. For that matter, names don't mean a great deal down there in the Choco.

It's a wild, God-forsaken country, that section of Colombia. A country in which a man's worth is measured in terms of iron nerve and fort itude.

He was a huge young fellow, this Hunky, built along the general lines of a gorilla. A thick trunk of a body, short legs and long arms, a low forehead, and a sloping brow. A likable fellow you'd say, with his genial smile and his laughing eyes, but about as hard a customer as you'd ever want to look at.

Sentiment? You'd expect to find more sentiment in an Andean condor. And yet Hunky was in truth a sentimentalist.

He was in love. No, not with a woman. He was in love with an homely heap of wood and steel as the ingenuity of man ever assembled. A platinum dredger.

Picture her, if you can. A big, lumbering, weather-beaten scow poking her slimy nose into a mud bank. A rusty bucket-line rumbling and growling as it ate its way to bedrock. A bow gantry and a stern gantry rearing grotesquely above the homely superstructure. A tailing stacker sticking out at the stern, dribbling its stream of gravel and rock. Mud and oil and dirt, and an eternal roar and clank of machinery.

To the rest of the crew she was a big unwieldy dredger with a habit of breaking down at inopportune moments, a soulless piece of mach nery for bringing gravel to the surface and washing out the plat num it carried. And they hated her cordially, for she wore their nerves ragged in their efforts to keep her running.

BUT Hunky loved her. To this big fellow, Number Four had a heart and a soul. To have seen him sitting on the river bank during his off hours, watching her slow-moving bucket-line eat into the opposite bank, one might have thought she belonged to him.

But she didn't. Hunky was only an oiler. He had started out as bankman, one of the crew which handles the mooring lines and digs holes for the "deadmen" that hold the dredger in position.

Where he had come from, how he had drifted down into that fever-ridden section of South America, no one seemed to know. But he had hired on as bankman, and thus in a country where no self-respecting white man would stoop to such labor, and had worked alongside the natives for months without protest.

At every opportunity, he liked to prowl around the big boat. He'd stand for hours watching the "grizzly," the big revolving screen into which the dirt is dumped by the bucket-line, and which separates the fine, platinum-bearing gravel from the coarser stuff.

He'd watch with loving eyes the long stacker belt as it carried its burden of tailings out to the stacker and dumped it at the stern of the boat. He was always under foot, staring, fascinated, at this and that piece of machinery.

THE winchmen, finding him in the way, would kick him off the boat a dozen times a day. He never protested. He merely showed his white teeth in a broad grin and went ashore, only to sneak back again at the first opportunity.

One of the winchmen, I think it was Tim O'Leary, discovered one day that Hunky was a strong swimmer. After that, when Hunky was thrown off the boat, he did not go ashore in a scow or a dugout. He swam. And possibly half an hour later he would be seen riding to the topside on the bucket line.

It was the superintendent, Lancaster, who found him, one day, working over the main pump with an oily rag. Hunky was

Hunky lay there gasping for breath, his great muscles trembling with exhaustion. One hand moved feebly toward his neck. "Fuse!" he muttered

caught red-handed in a place he had been ordered out of a hundred times.

"What are you doing here, Hunky?" Lancaster demanded.

Hunky blinked, swallowed, twisted the oily rag with nervous fingers. "Me—I—I ain't doin' nothin', Mr. Lancaster," he managed to say.

"Don't you know that a bankman's place is on the bank?"

"Y-y-yessir."

"THEN what the devil are you doing aboard the boat?"

"I—I—I'm off shift, sir. This here pump was gettin' a li'l rusty. I was polishin' it up a bit."

"H-m. Anybody tell you to polish it up?"

"N-n-no, sir. I—I just thought it wouldn't do no hurt."

"H-m. Know anything about these boats, Hunky?"

Hunky's huge barrel chest expanded. "I know *all* about 'em, sir."

"Think you could hold down a job as oiler?"

Hunky staggered a little and clutched at a tie-rod for support. His mouth opened but he could not find words.

"Well, how about it?" Lancaster demanded. "Could you hold down the job?"

Hunky swallowed again, audibly. "Y-y-yessir."

"All right. Allison is changing over to Number Two tomorrow. Go to work on the morning shift with Tim O'Leary."

That was how Hunky graduated from bankman to oiler. And he was as good an oiler as ever worked on a dredger. Keeping the moving parts of the big boat bathed in lubricant was only a small portion of his labors. He polished, painted, and scrubbed. He cursed the oilers on the other shifts for their untidiness. He fought with the watchman to keep the wheelroom deck clean. He worked the eight hours of his shift and came back for more.

His was a true labor of love. A month after he went to work as oiler, Number Four looked like a new boat, instead of the ten-year-old scow that she was.

And three months later Number Four handled 140,000 cubic yards of dirt in a thirty-day period, a new record. And Hunky was probably more proud of it than the superintendent. No one seemed to understand how it had been done. Possibly it had been sheer luck. And possibly Hunky had set an example that had inspired the whole crew to greater efficiency.

The rainy season came around. At least, they call it the rainy season, though in a country where there is some two hundred inches of rain a year, one season seems almost as rainy as another. The San Juan, where Number Four was working, went on its usual rampages. Muddy, swollen with débris, it would rise twelve or fourteen feet in as many hours.

It was dangerous business for dredgemen. Lives at stake. Two hundred thousand dollars worth of dredger in the balance. It was a game that called for nerve, and judgment, and iron constitutions—and loyalty. And Hunky had them all.

HUNKY and Tim O'Leary had the graveyard shift on this particular night. It was storming wildly. The rain was beating down in sheets. The wind was roaring through the jungle around the clearing. The river, black with tropic mud, was singing an ominous song.

Number Four was in a bad place on a turn of the river across from the camp. Ordinarily a platinum dredger has a pond of its own, where it is comparatively safe from the vagaries of the

main stream. On this night, however, the big boat had worked out dangerously near the main channel.

To be sure, her tailing stacker had thrown up a bulwark of sorts which protected her from the full sweep of the current. But tropic rivers play strange tricks. With their beds disturbed by dredging, with their levels rising ten or fifteen feet above the normal, they may change their channels overnight. And woe to the luckless dredger that gets in their way.

The river was rising steadily. Bob Purcell, the dredgemaster, and Lancaster, the super, had worked all evening in the pouring rain and howling wind. They had the native crew of bankmen out, they had sunk new "deadmen" and doubled up the headlines.

Hunky, though he did not go on shift until eleven o'clock, had labored manfully with the rest of the crew, though no one had sent for him. There was a worried look on his face, and sweat and raindrops ran from his brow. From time to time, as he swung his shovel, he paused for a moment and stared out across the black, swollen stream, as though to assure himself that his beloved dredger was still safely anchored.

At ten-thirty Lancaster decided that sufficient precautions had been taken to protect the boat, sent the bankmen back across the river in dugouts to the native camp, and turned in. Hunky and Bob Purcell walked over to the power house to dry out their soggy clothes.

They found O'Leary cursing and pawing through the tool boxes. "Main fuse went out," the winchman said helplessly. The superintendent glowered back to the oars.

O'Leary sneered. "Guess we can handle her without him."

The big dredger was on the far side of the river. Her lights loomed faintly.

The current was swift in the main channel. Hunky had to fight every inch of the way. But at last he brought the scow alongside the dredger, leaped out, and made fast the painter.

They found the winchman and oiler whom they were to relieve in the winchroom. "How's she goin'?" Tim asked.

"Not too good." The winchman shook his head. "The river's risin' old Ned tonight. If it was left to me, I'd close down till this storm is over."

O'LEARY laughed. "Close down me grandmother's ghost! What kind o' yardage would we make if we closed down for every little storm that comes along? Ye'd better tell that one to Mr. Lancaster."

The winchman nodded. "Maybe I will."

The two members of the night shift dropped into their scow and shoved off toward the far shore. Hunky, a worried frown wrinkling his low forehead, went about his duties. As usual when going on shift, he went over the boat from end to end.

An hour had passed by the time he had made his rounds and returned to the winchroom.

"How's she look?" O'Leary asked with a grin. "Think we'll be floatin' down the river soon?"

Hunky blinked, swallowed, and rubbed his chin with his knuckles. "River's risin'. That port headline looks to me like she was givin' some. If that carries away, the current'll swing us around an' throw all the strain on the starboard lines. They'll let go, sure."

O'Leary laughed skeptically. "Did ye ever see one o' these cables bust?"

"No-o-o. But I've seen 'deadmen' pull out, particularly when the ground's all soaked up."

"An' when ye see another 'deadman' pull out, come an' tell me, will ye?"

Hunky failed to respond to the other's chafing. "I guess you'll know it without me tellin' you," he said quietly. "It'll mean the wreckin' o' the boat."

Hunky passed out into the beating rain, swinging his oil can.

An hour later he hurried into the winchroom. His face was white.

"Port side line carried away, Tim!" he shouted. "Better close her down an' get help.

O'Leary took one look at the oiler's (Continued on page 150)

STANDING in front of the roaring boiler that ran the turbo-generator which supplied electric power for Number Four and the other Consolidated dredgers farther down the river, Hunky glanced apprehensively at the dredgemaster.

"Think she's safe, Mr. Purcell?" he queried.

The dredgemaster shrugged. "Sure she's safe. Nothing to worry about, Hunky."

The oiler pulled out a greasy bandanna and wiped the moisture from his face. "I'd sure hate to lose her."

Purcell laughed. "*You'd* hate to lose her! You're a queer one, Hunky. Anybody would think that boat belonged to you, the way you fuss about her."

Hunky rubbed his chin with his knuckles. "Well, she's a good boat. An' it makes me sick to think of her gettin' away and bein' all smashed up."

The dredgemaster grunted. "Don't you worry about that. You keep her oiled. That's your job. The rest of us will see that she doesn't get away."

Hunky nodded dubiously. "Yeah, I'll keep her oiled."

Purcell turned toward the door of the power house. "I'm going to turn in now. Tell O'Leary to call me and Lancaster if the river rises higher or if anything crops up."

"Yes, sir. I'll tell him."

At five minutes to eleven Hunky went over to the bunkhouse. Tim O'Leary, the winchman on the graveyard, was standing in the doorway.

"Rotten night," Tim growled.

"Yeah," Hunky nodded seriously. "The river's up. They doubled up the headlines an' sunk two more 'deadmen.' I'm right worried."

TIM grunted. "Sure, an' it's about that starboard winch ye'd better be worryin'. Her bearin's was dry as a bone last shift."

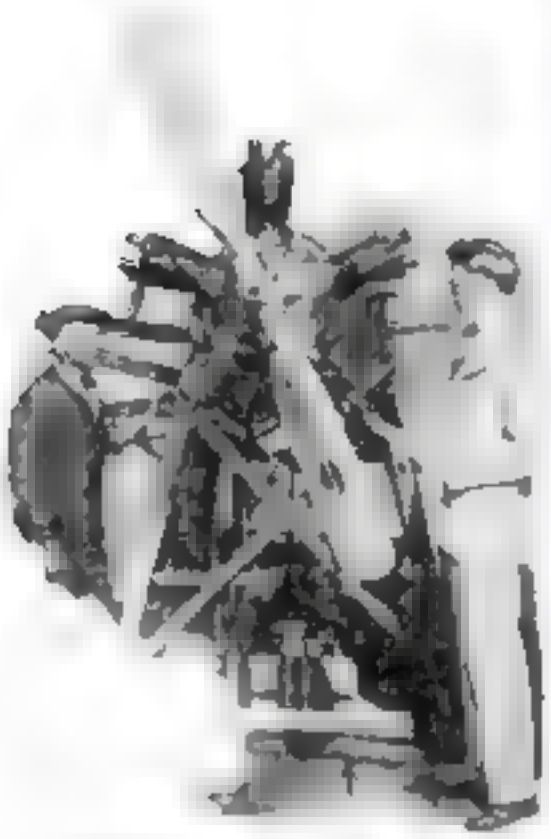
Hunky's eyes blazed. "Yeah, an' whose fault was it? That fool oiler on the night shift. You never saw no bearin's go dry on my shift."

"No? Well, ye want to see to it that I don't," Tim muttered.

They walked down to the river. A square-nosed scow was tied to the short pier. Hunky took his place at the oars. O'Leary huddled in the stern, his oilskins pulled up about his neck.

"Mr. Purcell said to call him if the river rises any more," Hunky said, as he shoved off into the stream and bent his head

News the Cameras Bring

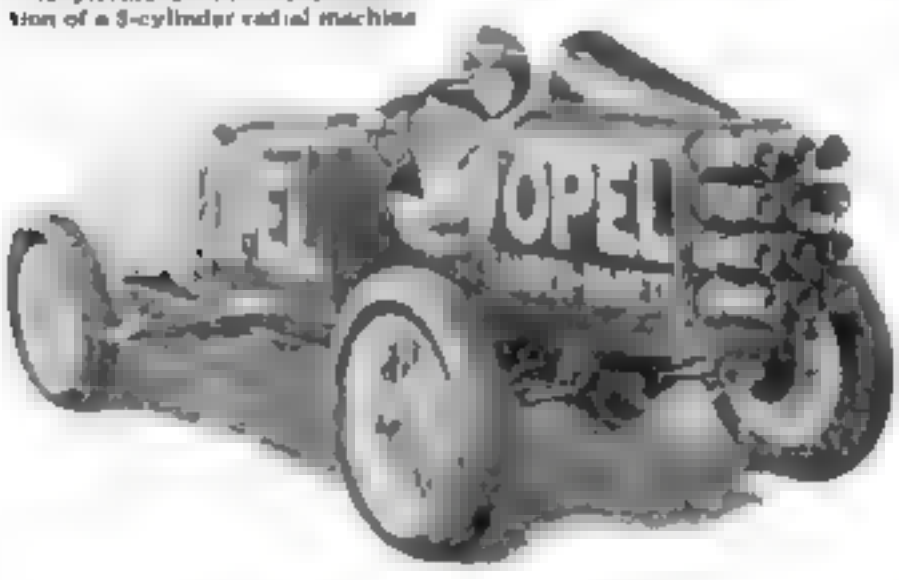


Aero Engines on Trial

Only airplane motors that pass severe tests will be certified by the U. S. Commerce Department under its system just established. The picture shows the examination of a 9-cylinder radial machine

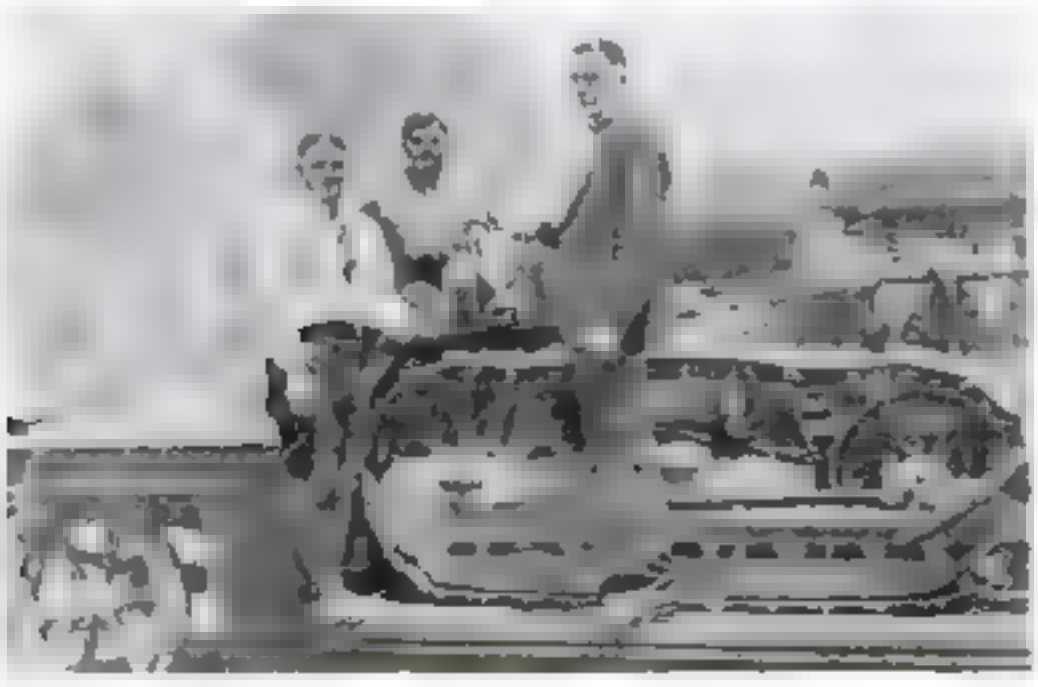
As a Bird Sees Two U. S. Fleets

An unusual airplane view of more than a hundred Naval craft anchored in Guantanamo Bay, Cuba, after recent maneuvers of the Atlantic and Pacific fleets. In the middle distance the hospital ships *Relief* and *Mercy* are identified by their white paint



Auto Driven on Rocket Principle

Driven by the force of the recoil from explosions of powder, which is converted into power applied directly to the axles, this new car invented by Max Valier, a German, is said to attain a speed of 60 miles an hour eight seconds after it starts. The inventor claims his idea solves the problem of feel wright



Nonstop Tractor Feat

"Joe" and "Bill" Battaglia, Californians, smash Australia's 148-hour world's record by driving a tractor ten days and nights. California University officials timed them. The Mayor of San Jose (right) presents them with a cup

A Pole Bound Flying Ship

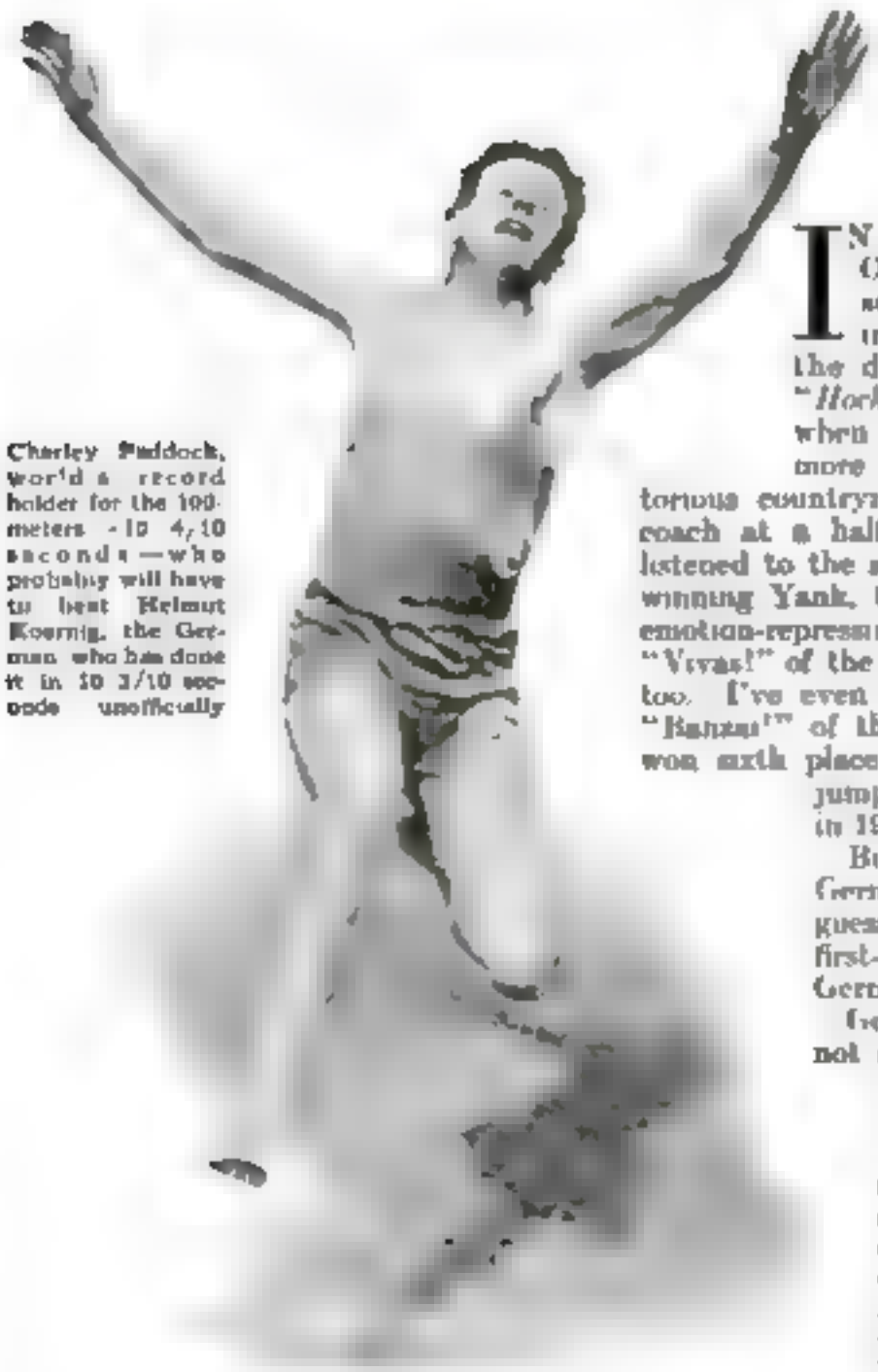
A striking photograph of the dirigible *Italia*, in which General Umberto Nobile plans to visit the North Pole, coming to earth in Pomerania after weathering storms for twenty-four hours since making start from Italy

Germany—"Dark Horse" of the Olympic Games

By LAWSON ROBERTSON

WATCH a car full of men reading the morning paper on their way to work. A glance over the main news and they turn to the sport page. Why? The answer is one word: Victory! The front pages tell largely of failure and defeat, of those who commit suicide, get divorced, go to jail. But the sport page tells of those who fight, win, conquer obstacles. In this article, a famous coach tells of noted athletes. It is a story full of youth, adventure, victory—the things that thrill us most. Here, too, is a story of a new German "Big Push" undertaken ten years after that of the gray-green wall.

The author Lawson Robertson, head coach of the United States Olympic team, who predicts victory in the Games at Amsterdam this year with Germany second and Finland third



Charley Paddock, world's record holder for the 100-meters (10 4/10 seconds)—who probably will have to beat Helmut Koernig, the German who has done it in 10 3/10 seconds unofficially

Harold Osborn, whose high jumping indicates an excellent chance for him to capture first in this Olympic event

IN AMSTERDAM'S Olympic Stadium this summer, for the first time in a long stretch of years, the deep-throated German "*Hoch!*" is going to be heard when "rooters" of a score and more of nations acclaim victorious countrymen. As competitor or coach at a half dozen Olympics, I've listened to the shrill "Attaboy!" of the winning Yank, the "Well run!" of the emotion-repressing Briton, the voluble "Vivas!" of the volatile Latins. Others, too. I've even heard the high-pitched "Banzai!" of the Japanese—when Oda won sixth place in the hop, step, and jump in Colombes Stadium in 1924.

But this year I'll hear the German "*Hoch!*" or miss a guess built on a thorough first-hand study of recent German athletic activities.

Germany is out to win—if not in this Ninth Olympics, then in the Tenth Olympics in Los Angeles in 1932. I don't think the Germans will be strong enough to beat the great team that we will send to Amsterdam, but they will probably beat the Finns for second honors, and by 1932 they will be dangerous rivals even to Uncle Sam.

Sometimes when I read what some high-browed gentleman has to say about our American "over emphasis" of sport, I have to smile. Compared to the preparation of Germany and some other European nations for this year's games, our preparation, thorough as it has been, seems almost casual.

I went to see what the Germans were doing to develop their Olympic team. I hadn't been in the stadium in Leipsic—the great general headquarters for German track and field sport—for two minutes when I realized the Germans were taking their athletics with characteristic national seriousness. While I waited to talk with Dr. Watzer, the national sport instructor, I was courteously requested to stop smoking.

"But," I objected, just to hear what he would say, "I'm not an athlete."

"That," I was told, "makes no difference. This stadium is devoted to physical development, and no one may smoke."

Almost 4,000 athletic clubs with a total membership of more than 500,000 athletes, Dr. Watzer told me, are controlled by the Governmental Board for Light Athletics that is promoting track and field athletics throughout Germany. The country has been divided into seven districts, each of which has its chief sport instructor, who travels from town to town instructing club sport instructors.

DeHart Hubbard the only man living so far as known who consistently can make a broad jump of 25 feet and who often goes over that distance. He seems a certain winner of this Olympic event

Lloyd Hahn, Nebraskan who is running star of the Boston A. A. and will meet Dr. Otto Peltzer in the 800-meters race at Amsterdam. Peltzer the greatest athlete ever developed by Germany holds the record but Hahn has done the fastest half mile: 1 51⅖.

Every town has its cinder track: almost every city its stadium. Today German athletes are credited officially with three world's records, have broken two others, and have come within easy striking distance of three more. In the last two Games we have won a third of the running events. Germany's strength isn't going to make it any too easy for us to win a third of the thirteen running events this year.

The finest athlete ever developed in Germany is Otto Peltzer, the blond six-foot Doctor of Philosophy who holds world's records at 500 and 800 meters and 880 yards, who has lowered the present official world's record for 1,500 meters, and who has won victories over the greatest middle distance runners, Paavo Nurmi of Finland, D. G. A. Lowe of Great Britain, and Edvin Wide of Sweden. If he can recover from his recent serious injury, the high spot of this year's cinder-path competition will come when Dr. Peltzer measures strides with the field of marvelous runners in the final of the 800-meters event.

Right here let me say that I am writing this before the final try-outs for our Olympic Team, so when I speak of some athlete as an Olympic contestant, please make the mental reservation "If he makes the team."

THE man who is likely to push Peltzer the hardest in the 800-meters is Lloyd Hahn, the Nebraskan who runs for the Boston A. A. Hahn has done the half mile in one minute fifty-one and two-fifths seconds—the fastest half mile ever run *officially*. It will take the best man in the world to beat him. The runner most likely to fight it out with Hahn and Peltzer is Douglas G. A. Lowe of Great Britain, the winner in 1924.

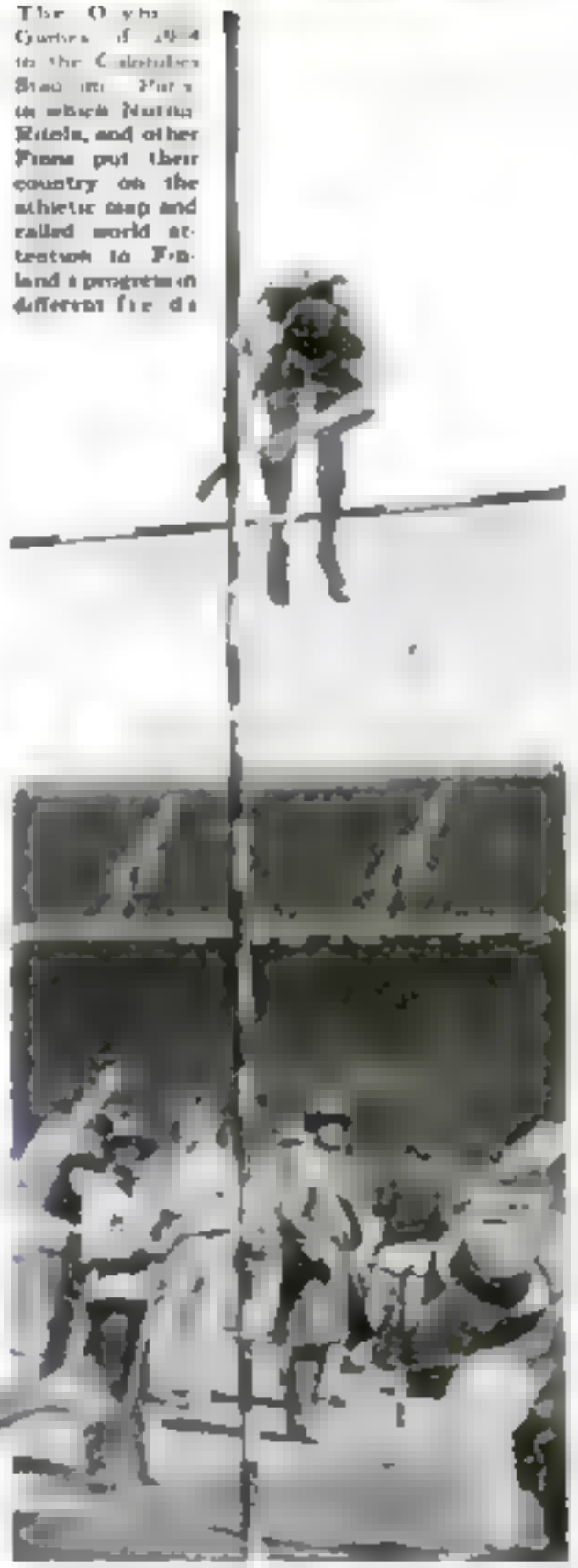
I'm rooting hard for an American victory in this event, but I am afraid Peltzer may win. But in Olympic competition you never can tell. Lee Barnes, a seventeen-year-old schoolboy, was a dark horse when he tied Lee Gehrmann for first in the pole vault in 1924. Eric Liddell, the Scotch parson who passed up his natural event because he wouldn't run on the Sabbath, was another when he won the 400-meters that same year. And Ted Meredith was a dark horse when he won the 800-meters in 1912. But the darkest horse of all was Paul Pilgrim when he won the 800-meters in Athens back in 1906. James D. Lightbody winner of three Olympic championships in 1904 came into the home stretch ten yards to the good. Then Lightbody slowed down, smiled at his admirers, and glanced back over his right shoulder to see how badly he had beaten the field. Pilgrim slipped between him and the pole, streaked for the tape, and won!

WHILE most things Olympic have improved considerably since I made my first trip to the big Games in St. Louis in 1904, the starting of the sprint races has remained almost uniformly bad. I cherish the hope that we'll get good starting in the sprints at Amsterdam. We're going to take ten mighty fine sprinters over on the *President Roosevelt*, and I want to see the sprints decided by hair raising finishes—not by poor starts.

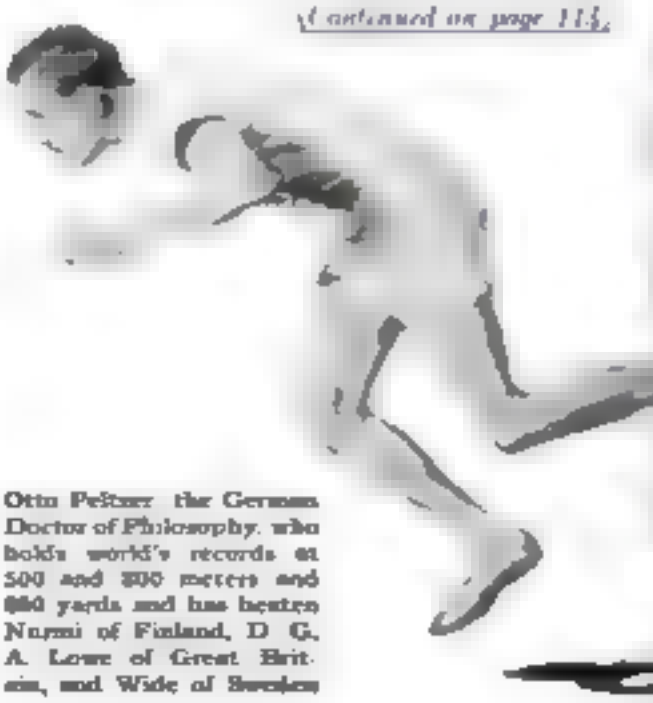
We have a good chance of winning both the 100-meter and

(Continued on page 114)

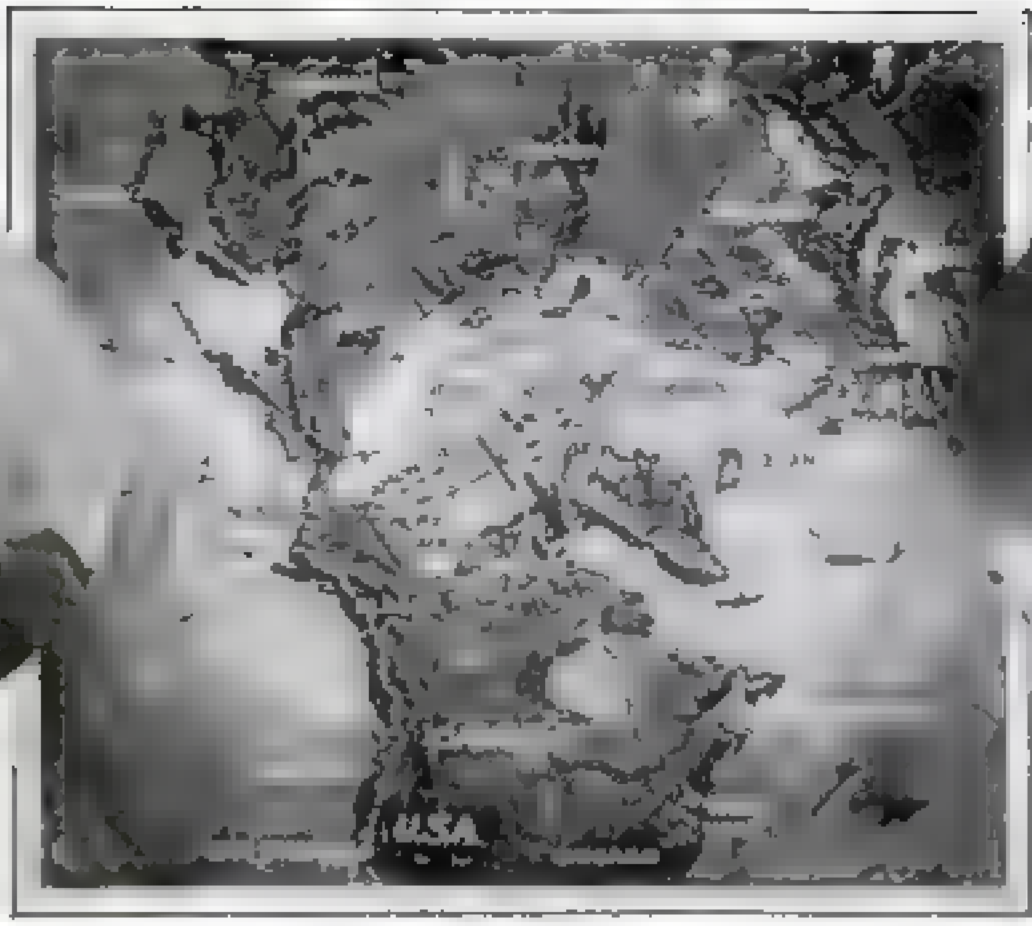
The Olympic Games of 1924 in the Colombes Stadium, Paris, in which Nurmi, Ritola, and other Finns put their country on the athletic map and called world attention to Finland's progress in different fields



Otto Peltzer the German Doctor of Philosophy, who holds world's records at 500 and 800 meters and 880 yards and has beaten Nurmi of Finland, D. G. A. Lowe of Great Britain, and Wide of Sweden



Sabin Carr of Yale, world's pole vault title holder who is expected to fight it out with Charley Hoff Norway. They are always over 13 feet



Carl Ben Eielson, Wilkins' pilot on the first completed America to Europe airplane flight over the Polar Sea. The map shows the route they blazed and previous Polar flights of Byrd and Amundsen

Captain George H. Wilkins, [illegible] the Polar Sea by airplane, showing, as indicated on the map, the way it shortens the distances between great world centers by direct air routes

Flyers Again Beat the Arctic

Continents Brought Hundreds of Miles Nearer Together by Wilkins and Eielson in Polar Flight

By ELLSWORTH BENNETT

OVER a bleak, uncharted desert of ice, two fur-clad explorers sped in a little streamlined monoplane, blazing an air trail across the Polar Sea. Apparently angered at such daring, the Arctic loosed its fury—hurling upon them blinding snow and roaring winds. Under the lashing, the winged machine reared and tossed defiantly—and rode through the storm unscathed.

A message flashed to an astonished world. It said that the little ship with its two birdmen—Captain George H. Wilkins, Australian explorer, and his American pilot, Carl Ben Eielson—had safely crossed the mysterious "blind spot" of the earth, from Point Barrow, Alaska, to Green Harbor, Spitzbergen. In twenty and a half hours they had gone 2,200 miles on the wing—three fourths of the way over perilous regions never seen before by man.

That amazing flight of April took the world by surprise.

The article in last month's POPULAR SCIENCE MONTHLY, detailing the Polar plans and purposes of Wilkins and of General Umberto Nobile and based on the latest authentic information available, was written with no idea that either explorer's flight would be made so soon.

In the words of Commander Byrd, the Wilkins adventure was the greatest flight ever made in the North. And Roald Amundsen, veteran Polar explorer, declared "no flight has been made anywhere, at any time, which could be compared with it."

Why?

First of all, it brought near to practical achievement a dream of centuries—a northern short cut for commerce across the world. The map on this page shows how the trail they blazed will shorten by hundreds of miles the distances between the world's great centers: for example, between New York and Peking, or London and Tokio, or San Francisco and Moscow. Here may be seen a future crossroads of commerce, where winged ships will pass under the midnight sun.

EQUALLY important was the contribution to scientific knowledge, particularly meteorology. Wilkins' chief goal has been to establish five stations near the North Pole and twelve near the South, from which weather in the temperate zones might be forecast years in advance. To this end, observations during his Arctic flight are invaluable.

Finally, the exploit was a supreme triumph for aviation. Probably no flight was ever made in the face of so many unknown hazards or such difficult problems of navigation. Trans-Atlantic flyers have had continents to aim at. Wilkins had a tiny island—a mere speck in thousands of miles of sea and ice. That he and Eielson reached their goal was due to careful planning, scientific preparation, and courage in overcoming fearful obstacles. They deliberately plotted a course that carried them 300 miles south of the pole at the nearest point. Heroic perseverance after repeated discouragements carried them through.

It was Wilkins' third attempt and Eielson's second, and at first it seemed as though ill fortune still trailed them. The little Lockheed Special plane, weighing 1,800 pounds, was loaded with 3,400 pounds of fuel and supplies. Four attempts to get it into the air failed, and three times its skis were wrecked. At last, on Sunday, April 15, they rose and sailed into the unknown.

On they flew past the forbidding peaks of Grant Land, and as they neared the little speck which was their goal, a swirling buzzard flung itself around their little ship. Wilkins was hurled from his cabin seat. Eielson hung to his steed like a broncho buster and nosed it downward in the blinding snow with supreme skill to a safe landing on desolate Dead Man's Island, only thirty miles from their destination.

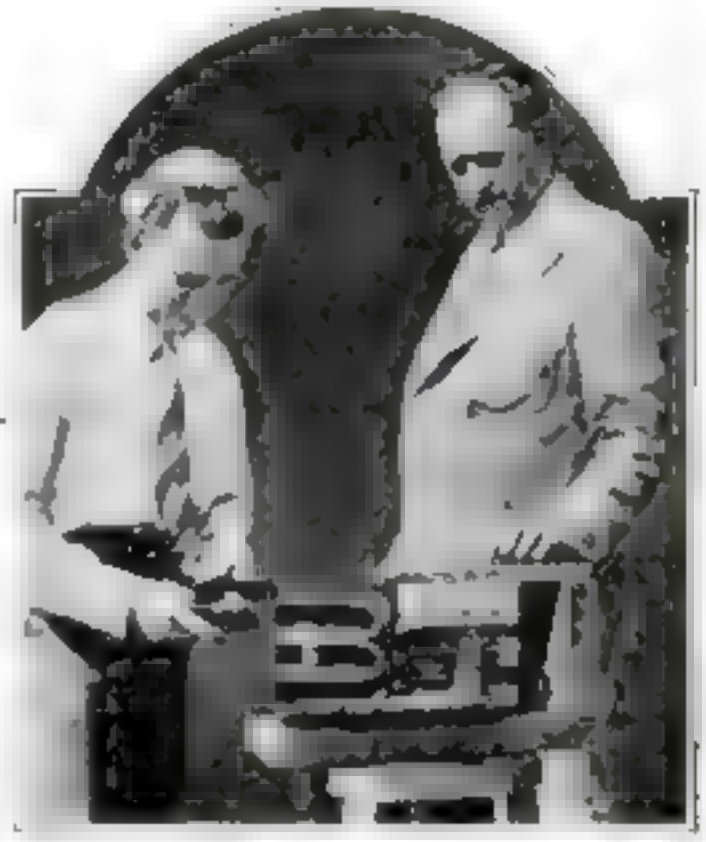
There the flyers remained stormbound for five days. When the storm subsided they managed, after three thrilling attempts, to fly to Green Harbor, whence Wilkins sent his victorious message.

So the Arctic is robbed of more of its mystery. Now millions wait while Wilkins and Byrd plan soon to speed by plane into the frozen fastnesses of the Antarctic.

The Truth *about* Fuelless Motors

An Illuminating View of the Latest Claims of Power Out of Nothing—The History of Perpetual Motion Hoaxes

By E. E. FREE



D. E. Lane (left) and J. A. Townsend with the original model of their "magnetic motor" which they say uses magnetic energy stored in hard steel

IF JAMES WATT had died of whooping cough as a child, would the steam engine have been invented? If the Morses had had no son Samuel, would telegraphic communication be unknown? Do great inventions hang upon individual genius or upon an accumulation of knowledge?

¶ Before you decide, read this article by Dr. Free, president of the New York Electrical Society. Tracing man's quest for a fuelless motor, he concludes that if success comes, it will be through many experimenters advancing step by step, rather than by individual geniuses.

¶ Great inventions grow like a coral island, instead of suddenly like a volcanic peak thrust above the sea. They are built of innumerable small discoveries by many men. Science expects long, patient plodding before the fuelless motor can be a reality.

THE Hendershot "fuelless motor" announced recently by Lester J. Hendershot, of a suburb of Pittsburgh, has brought numerous similar proposals in its train

A Brazilian priest, Father Antonio d'Angelo, has declared his "tone motor" runs by some mysterious property of the iron cores and magnets it contains. D. E. Lane and J. A. Townsend, of Clearwater, Fla., make similar claim for their device Alfred M. Hubbard, of Seattle, claims to have invented a motor driven by some equally novel "energy" of the air. Two Bavarian inventors, Frederich Brandhuber and A. Altschaeffl, describe a motor tapping the same source of energy claimed for the Hendershot motor, the magnetism of the earth.

The Hendershot motor operates, he says, by "the same force that pulls the needle of the compass around. I learned that by cutting the same line of magnetic force north and south I had an indicator of the true north and that by cutting the magnetic field east and west I could develop a rotary motion. I now have a motor built on that principle that will rotate at a constant speed, a speed predetermined when the motor is built. It can be built for any desired speed, and a reliable constant speed motor is one of the greatest needs of aviation."

Barr Peat, friend and manager of Hendershot, asserts that the device contains a special magnet so wound with wire coils that the motor rotates in a direction opposite to the rotation of the earth beneath it. This magnet will have to be "recharged," according to Peat, after 2,000 hours of operation. Absence of heat when the motor is running is due, Peat says, to the fact that "magnetic forces are cold"—a statement with which most scientists would disagree.

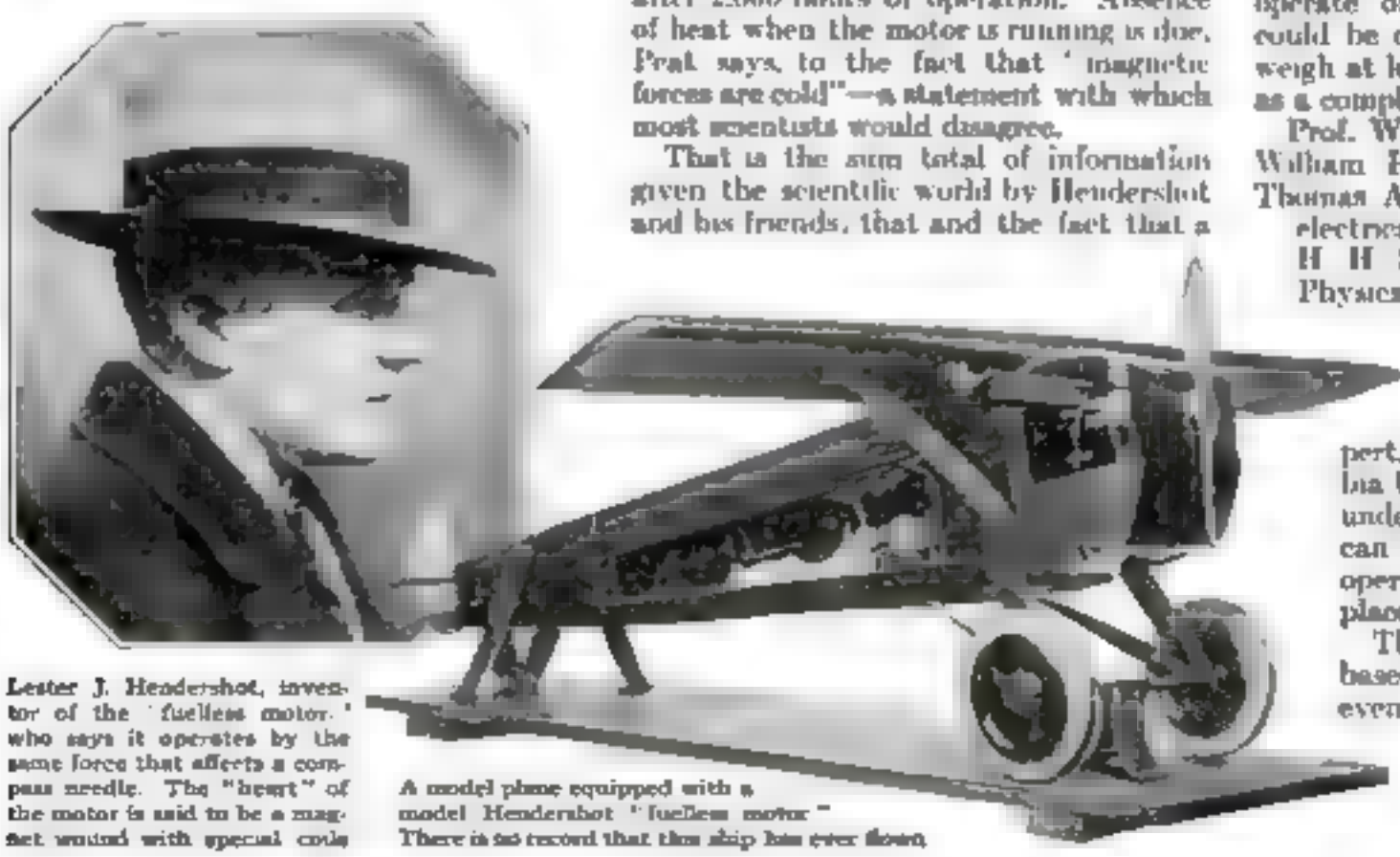
That is the sum total of information given the scientific world by Hendershot and his friends, that and the fact that a small model has actually been seen to run by persons of unquestioned integrity. As this article is written no independent expert of recognized scientific qualifications is known to have taken the motor apart or to have subjected it to complete engineering tests.

CONCERNING the magnetic theory and other theories recently urged by the several inventors of fuelless motors, scientific opinion has been severely skeptical. Prof Alexander Klemin, head of the Guggenheim School of Aeronautics at New York University, has expressed doubt of the possibility of any such motor. So has Dr. J. B. Whitehead, Dean of the Engineering School of Johns Hopkins University President S. W Stratton of the Massachusetts Institute of Technology, remarks that even if a motor to operate on the earth's magnetic field could be constructed, it would probably weigh at least a thousand times as much as a complete airplane.

Prof. W B. Hall, of Yale University, William H Meadowcroft, assistant to Thomas A. Edison, and a distinguished electrical expert in his own right, Prof H H Sheldon of the Department of Physics of New York University, and many others, share the doubt.

America's most distinguished electrical expert, Prof M I Pupin, of Columbia University, has said, "I cannot understand how sufficient power can be generated in this manner to operate a heavy object. I fail to place any confidence in it."

This skepticism of science is not based upon mere conservatism, nor even upon recollection of the thousands of power-from-nothing devices which have been proposed and found want-

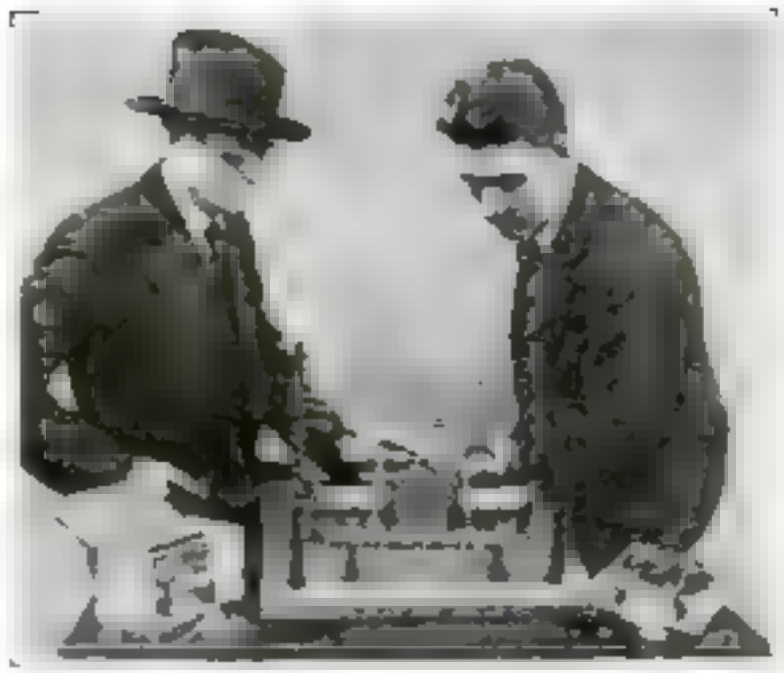


Lester J. Hendershot, inventor of the "fuelless motor," who says it operates by the same force that affects a compass needle. The "heart" of the motor is said to be a magnet wound with special coils

A model plane equipped with a model Hendershot "fuelless motor" There is no record that this ship has ever flown

ing. It rests upon the fact that such theories are believed definitely contrary to known facts.

It is quite true that the earth is a great magnet. If a pair of giants could wave a thousand-mile wire back and forth across the magnetic pole of the earth, as scientists move small wires past the poles of magnets in the laboratory, they might obtain a few horsepower—no more—of electric current, pulsing through the wire. In a small space like that which could be occupied by an airplane motor or from which electric or magnetic forces could be tapped by wires or rods attached to the airplane, the amount of the earth's magnetic force available would have to be measured in gnat power, not horsepower.



R. W. Hochstetter (left, Pittsburgh research expert) shows how tiny hidden batteries run fuelless motors which he has built to demonstrate how easy it is to hoax observers with these devices

THIS conclusion rests on many thousands of measurements of the magnetic forces of the earth made by scores of scientists in every civilized country and carried around the world and even over the oceans.

But to criticise this magnetic theory all one needs is an ordinary woodsman's compass. Take off the glass top and touch the moving needle. Note the tiny force that will keep it from pointing toward the north. The weight of a feather is ample. Yet the compass is as efficient a magnetic engine as any well-tested device known to science. If any fuelless motor really works on the earth's magnetic energies, the greatest power it can develop is believed to be the power shown by a magnetic needle of equal size.

The electric forces of the earth might seem more probable sources of power than the magnetic ones. Sometimes these electric potentials run into millions of volts, as is apparent when lightning strikes. Anyone who has nerve enough to repeat Benjamin Franklin's experiment of bringing down lightning on a kite string can use it to light a tiny lamp or to turn a small motor.

ONE ingenious device that is really a motor run by atmospheric electricity rings a small bell, hung a few yards above the ground and so arranged that it collects a little of the atmospheric electricity. The attractive force of this electricity, like the force by which electrified rods pick up bits of paper, is then made to drive the small clapper of the bell. Never, except perhaps for a few moments while the electricity of the air is changing, will the tinkle cease so long as the apparatus is in working order.

Although much more powerful than the earth's magnetic forces, these electric forces are still far too weak usefully to operate a motor. In a recent statement the Department of Terrestrial Magnetism of the Carnegie Institution of Washington calculated that the energy obtainable in theory by catching the electricity of the atmosphere over the entire state of Wisconsin would total only twenty kilowatts of power—enough, at its dangerously high voltage, for one dim electric lamp.

The record of attempts to find some source of free power or perpetual motion goes back at least seven centuries, for there is preserved in Paris a drawing of a "self moving wheel" devised by Wilars de Honecort about 1230. About 1648 Edward Somerset, Sixth Earl of Worcester, invented a similar device, and so did Jean Ernest Ehe-Bessler Orffyreus, of Cassel, in Germany, in 1718.

Early in the last century Charles Redhoffer, of Philadelphia, constructed a "fuelless motor" the fraud of which was exposed by Robert Fulton, inventor of the steamboat. It was operated by a cunningly hidden string. The famous Keely motor in Philadelphia was a fake worked by compressed air.

Two years ago in the House of Representatives in Washington there was debated the merits of a free-power motor invented by Garabed T. K. Giragossian, of Boston. The Patent Office had declined to consider this device until an operating model was submitted, a policy now followed in all claims for devices producing perpetual motion or power out of nothing. So far no American inventor has met this demand.

Is the quest for a fuelless motor, then, entirely hopeless? Not at all. Sources of unharnessed energy do exist, all scientists believe. The power of the winds is almost untapped, the waves likewise. Greater still are the energy of the tides and of the earth's motion. Sunlight is still very little used. But if these theoretical sources of fuelless power are ever reached for man's benefit, it will probably be by the labor of trained scientists slowly advancing step by step, not by accident.

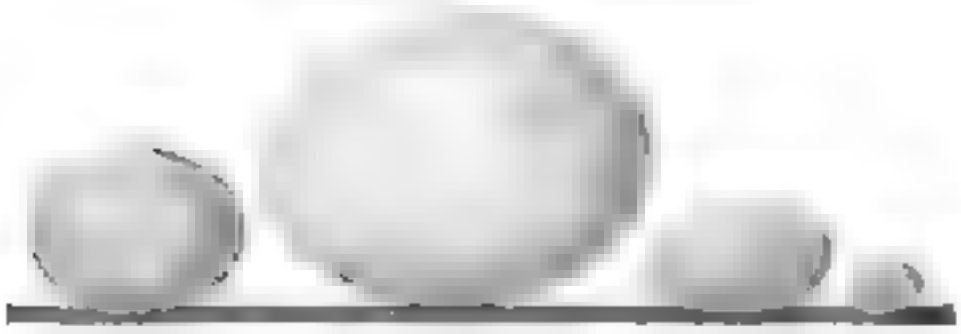
When someone comes to you with a fuelless motor, seeking approval or investment, the first question to ask is: Has the device the backing of reputable scientific men who are personally expert in whatever forces the device purports to use? The next query is whether the device really produces power to run other machines? And can its power output be measured on standard meters of some kind? And is this power output greater than any power put in?

Even if a motor meets these tests, you must still watch for plain fraud, like the concealed storage batteries said to have been hidden in the cushions of the engineless automobile exposed not long ago in Kansas City.

With any alleged fuelless motor it is necessary to be suspicious of all supports, rods, belts, wires, and other connections to walls or floor, no matter how innocent these seem. Each one should be disconnected and examined. What appear to be solid pieces of wood or metal used as bases, magnets and so forth should be examined for hollow spaces concealing batteries or reservoirs of compressed air or other powers. Possible supplies of electromagnetic energy from coils concealed in walls, floors, or tables must be looked for and excluded. Remembering how many hoaxes of the past have fooled men of average high general intelligence, who nevertheless lacked the special and technical knowledge that can be gained only by years of study, and remembering how the hoaxes have puzzled even experts who, though their knowledge of natural forces made them suspect trickery, were unable to discover that trickery—you should not depend upon your own judgment and your own ability to detect deceit unless you are yourself an expert in the subjects which the invention concerns. Only a scientist is fit to judge a scientific invention.

Any day it may be proved that man's ingenuity has contrived a real fuelless motor, but meanwhile man's ingenuity will contrive device after device based on nothing but clever fraud.

Father Antonio d'Angelo showing his "lotic motor" which still must pass tests of science. Above: G. Reutter and his clock that rewinds itself



Four eggs from Africa. Left to right: ostrich, aepyornis maximus (with a capacity of two gallons), albatross, and ordinary chicken

Now I'll Tell One—About Africa

True Stories That Sound Like Fibs of the Land in Which Ant Hills Are Big as Houses and Hens Lay 24 Eggs at Once

By THOMAS W. PHELPS

IN AFRICA stone floats, paper flowers grow wild, trees wear feathers, and fish wriggle out of the ocean to sun themselves.

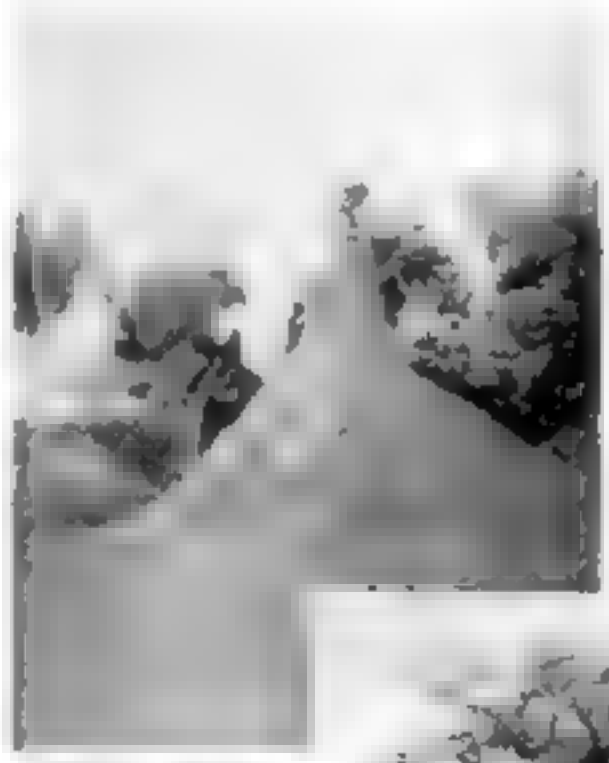
Hens taller than a man lay two dozen eggs at a time, packed in one stout shell for the convenience of wholesale bakers. Blossoms spread their petals and fly away when picked, leaves turn into butterflies, twigs into bugs, and birds make a business of leading hungry travelers to hollow trees full of honey.

There are trees that are said to cure fever, snowstorms on the equator and ants that build hills as high as houses—but the shades of Baron Munchausen, Sinbad the Sailor, and others of the Ananias Club warn me to stop and explain while I can.

Evidence that stone does float when conditions are right is the principal attraction of the great Congo Caves, a few miles from Oudtshoorn, South Africa. A Boer farmer broke three ribs while exploring the caves when the stone floor suddenly gave way beneath him. Hours later he came to, at the bottom of what had once been a subterranean lake. Overhead like ice left across the top of a suddenly drained water tank in mid-winter, was a sheet of limestone half an inch thick, that must have been deposited on the surface of the water that had stood there thousands of years.

In most of South Africa it rains in seasons of roughly six months, followed by six months with hardly a cloud. On Table Mountain, just behind Cape Town, Nature has met the problem by evolving a white, paper blossom called the everlasting flower. It [illegible] like paper and will keep indefinitely without water. On the same mountain, and only on the Cape peninsula, are trees covered with what look like silver feathers, instead of leaves.

At Durban, on the east coast of South Africa, is the white mangrove tree whose roots stick up out of the sand. There the mud skippers—mudmows—daily flop out onto the shore, climb the mangrove roots,



A giant gets on the [illegible] Northern Rhodesia. Right: A South African baobab tree, whose fruit is believed by the [illegible]

and when disturbed take refuge [illegible] a kind of [illegible] mud crab.

[illegible] the first [illegible] [illegible] Congo [illegible] at [illegible]

two-one" cake. Ingredients are four [illegible] of flour, three of sugar, two of butter and [illegible] ostrich egg, roughly equivalent [illegible] two dozen of our chickens' eggs. Bigger by far than the ostrich though, was the aepyornis maximus, a Madagascar fowl now extinct, which stood eight or [illegible] high and laid an egg three feet in circumference. Unbroken aepyornis [illegible] eggs discovered so far have proved too old to hatch.

Do you doubt that a blossom may spread its petals and fly away? Perfectly possible in Africa where leaf hoppers, [illegible] to yellow in color, arrange themselves in the form of a flower, probably for protection against their natural enemies. There is a leaf butterfly which plays a similar joke on people. The tail on its wings resembles the stem of a leaf, and a dark line down the middle of its wings passes for the midrib.

HONEY guides are found all through South and Central Africa. South Africa has five species alone. The birds call persistently to attract attention, then, when you walk toward them fly from tree to tree where bees nest. After the honey has been removed they rush in and eat the young bees. Their only weakness as guides is that they like young wasps.

In the eastern Congo it is possible to sit in the midst of a luxuriant banana plantation and with field glasses watch a blizzard raging on top of Margherita, the highest peak in the mountains of the Moon group. Kilimanjaro, the highest mountain in Africa, 19,710 feet, and Kenya are likewise snow-capped. The equatorial African mountaineer must guard against sunstroke and frozen feet at the same time.

Smaller mountains, but no less remarkable considering how they come to be, are those erected throughout Central Africa by ants. On the aviation field at Ndola, Northern Rhodesia, is an observer's stand built on top of an ant hill

A South African Railways photograph of the "ice chamber" in the Congo Caves. Above: The insect that looks like a stick alone and on a twig

IS YOUR wife as smart as you? How many times have you argued the point! Did you ever settle it? Here, for the first time, a psychologist of recognized ability presents a scientific answer.

¶ Mr. Lecky, a member of the Department of Psychology in Columbia University, has been investigating the subject for years. He tells, in a fascinating way, why the world has produced thirty-one famous men for every woman genius, and how mysterious forces cast the sexes for widely different rôles in life.

¶ You may not agree with the author, but you will be interested in his reasons for believing that men are originators and women imitators.

The one woman genius of science—Madame Curie, discoverer of radium

ONE to

An Answer to the Age-Old Question:

Are Women As Smart As Men?

By PRESCOTT LECKY

YOU'R wife or girl friend no doubt will admit, with little argument that women the world over are, on the average, shorter in stature, lighter in weight, weaker in muscles, and have smaller brains than men.

But ask her to agree that women are inferior mentally—then watch out for the fireworks!

For ages—from the time the cavemen first drew pictures on the walls—the male assumption of supremacy in intelligence remained almost unquestioned. But not in our generation! The glorious modern female, newly freed in body, newly independent in action and expression, rises vigorously to challenge the time-honored assumption.

Are women as smart as men?

"We'll say they are—and then some!" is the unanimous feminine answer whenever the argument begins. And an increasing array of witnesses has arisen to support the contention. Only the other day, for example, Count Keyserling, the famous German philosopher, summed up his impressions after a tour of the United States with the statement, in effect, that the so-called "weaker sex" actually is dominating America; that what we possess of higher thought, feeling, and intelligence is being preserved through the genius of American women.

But that was purely an opinion. A far more telling and specific argument to most people was the result of an examination of the brain of the late Mrs. Helen H. Gardener of Washington, D. C. This brilliant feminist, you remember, was the first and only woman Civil Service Commissioner of the United States. She willed her brain to Cornell University for study. The study was made by Dr. James W. Papez, who announced that it "presented abundant evidence that the brain of a woman need not be inferior to that of a man of equal rank."

AT ONCE this cautious statement was heralded as proof of the mental equality of the sexes. One newspaper even proclaimed a decisive victory for womankind. Is such a conclusion correct? Let's look at the facts:

Mrs. Gardener's brain was found to weigh 1,150 grams. It happened that the brain of Dr. Burt G. Wilder, one of the founders of the Cornell brain collection, also weighed 1,150—whence, evidently, the comparison with "a man of equal rank." Yet both were lighter than the brain of the average man, which weighs between 1,300 and 1,400 grams. Three are known to have weighed more than 2,000 grams. One was that of the Russian novelist Turgenev.

As to quality, Mrs. Gardener's brain was found to "reveal a wealth of gray matter that is only equaled, but not exceeded, by the best brains in the Cornell collection."

Here, then, we have one woman's brain, of fair size and high quality. What does it prove?

Absolutely nothing.

As a matter of fact, the once accredited practice of reading person's mental abilities by the size and shape of his head, or, after death, by examination of the dead brain tissues, has passed to the limbo of science's discards.

Recently I read two significant newspaper dispatches. One told of the discovery of a skull with a record-breaking brain cavity; the other, of a scientific study of a brain far below normal size. Who, do you suppose, had possessed the giant brain? A superstitious, ignorant savage, living in the heart of Africa! And the little subnormal brain had been the mental storehouse of the great writer, Anatole France! Again, I spoke a mo-

THIRTY-ONE

ment ago of three male brains each of which weighed more than 2,000 grams. One of these was the brain of an imbecile!

No, you can't judge smartness by the size of a head nor can you and your wife settle the point of superiority by comparing hat bands!

Well, then, how can the argument be settled?

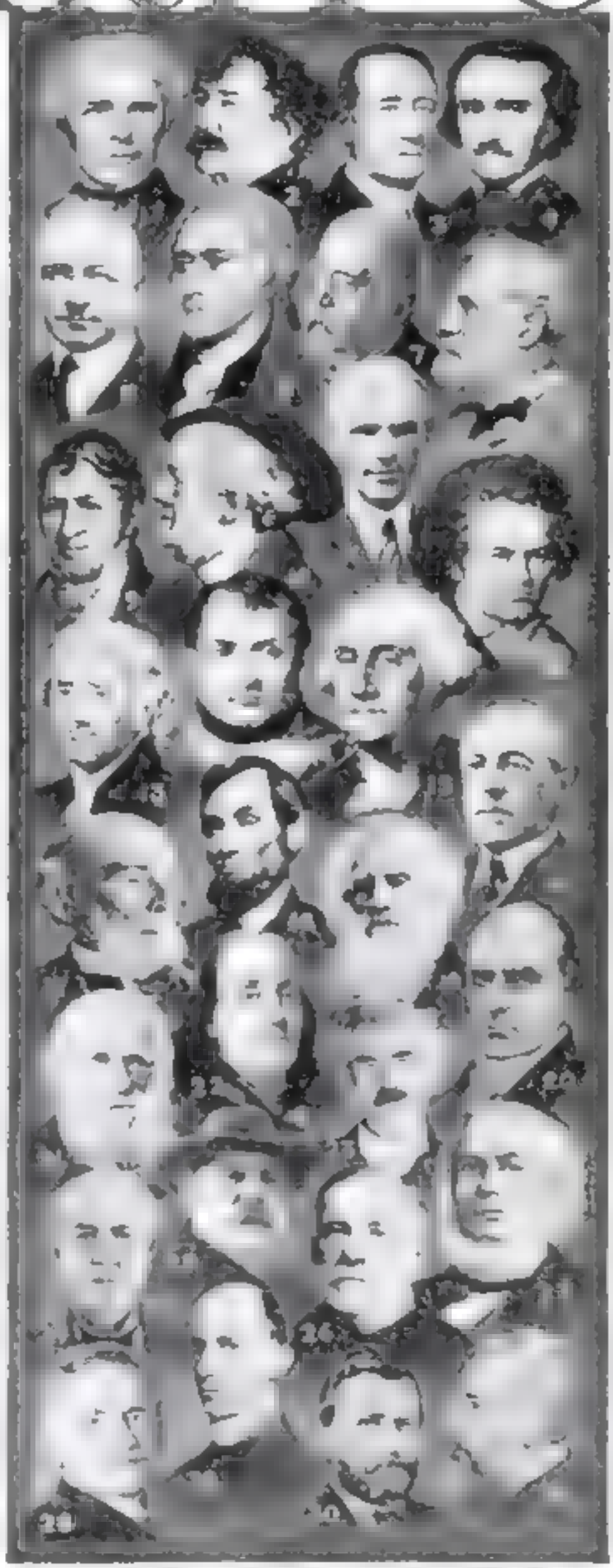
For one thing, we can turn to the records of history. Intellectual achievement is the only practical measure of mental power. How, then, have women compared with men in actual performance?

Dr. J. McKeen Cattell, formerly Professor of Psychology at Columbia University made a careful study of the thousand most noted individuals, the geniuses of the world's history. He found that only thirty-one were women. In other words, the proportion of great women to great men has been in the ratio of one to thirty-one!

And of the thirty-one women, Doctor Cattell found eleven were hereditary sovereigns, and eight became eminent through misfortunes, heredity or other accidental circumstances. Two gained fame in literature—the only department in which women have accomplished much—as compared with seventy-two men in that field. The two remaining women were Sappho, the ancient Greek poetess, of whose work we know almost nothing, and Joan of Arc, sainted heroine of France.

IT IS almost exclusively in emotional expression that women have obtained eminence at all. The most recent study of the fields in which modern women have gained prominence shows that 51.6 percent are writers, 16.7 percent musicians, and 11.2 percent actresses. Jane Addams, the great social reformer of Hull House, Chicago, stands alone among women as an eminent sociologist, and Madame Curie, discoverer of radium, is the only truly great woman scientist.

In short, all the records point to the inevitable conclusion that women have failed to measure up to men in practically every field for which statistics are available.



Members of the staff of POPULAR SCIENCE MONTHLY selected these as thirty-one representative masculine geniuses. See how many you can identify then check your answers on page 139. Do you agree with this selection? Write to us, giving your opinion on this interesting topic

Why is this? Why is feminine genius comparatively rare?

"Because women are naturally less intelligent," say the men.

"Then why don't the standard intelligence tests show it?" retort the women.

And there's the rub. For the tests reveal that the average girl in grade school scores higher than the average boy. Her memory is better, her senses are a little keener. Her average marks are higher. She more frequently skips grades and less often fails to pass. Mentally she is older than the boy of the same age until she approaches maturity, when the boy overtakes her. College girls and youths have approximately the same average scores. All in all, there seems to be no important difference between the sexes in average natural intelligence.

BUT let's inquire further to learn what *kind* of smartness each displays. We find at once that the girl surpasses in subjects which require no high degree of reasoning or creative thinking—such as spelling, English, and foreign languages. She accepts words and rules as they are taught, and learns them well without necessarily reasoning why. As a rule she doesn't ask such questions as, "Why isn't *pie* spelled like *my*?" or "Why do the Germans put the verb at the end of the sentence?" Son has greater respect for the teacher and for every source of authority. By following the beaten path she gets higher marks.

The boy, on the contrary, takes less for granted. He wants to know why. He is forever scheming and figuring. He excels in such subjects as physics, mathematics, chemistry, and history which require more original thought and investigation. And he is far superior in ingenuity, in devising ways to do new things. He is more the creative thinker.

This vital difference in *kind* of intelligence persists in later years. On the whole, women in mental make-up are more the imitators and followers, men the originators.

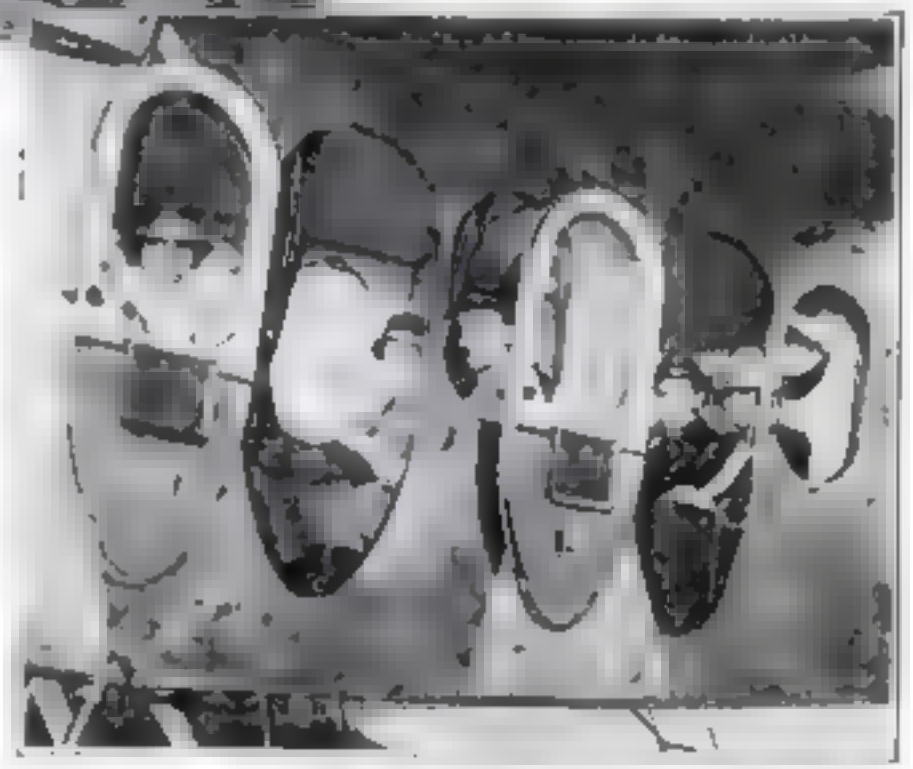
[Continued on page 156]

Comfort and Luxuries Now Offered Air Travelers

Passengers read newspapers and magazines with Pullman comfort in the big cruising cabins of the new air liner planes that ply between Berlin and Moscow

An office where business men can dictate letters in the clouds is part of the equipment of this new transport plane

The promenade deck of the *R 100* whose recent flight to America was announced in the January issue of Popular Science Monthly

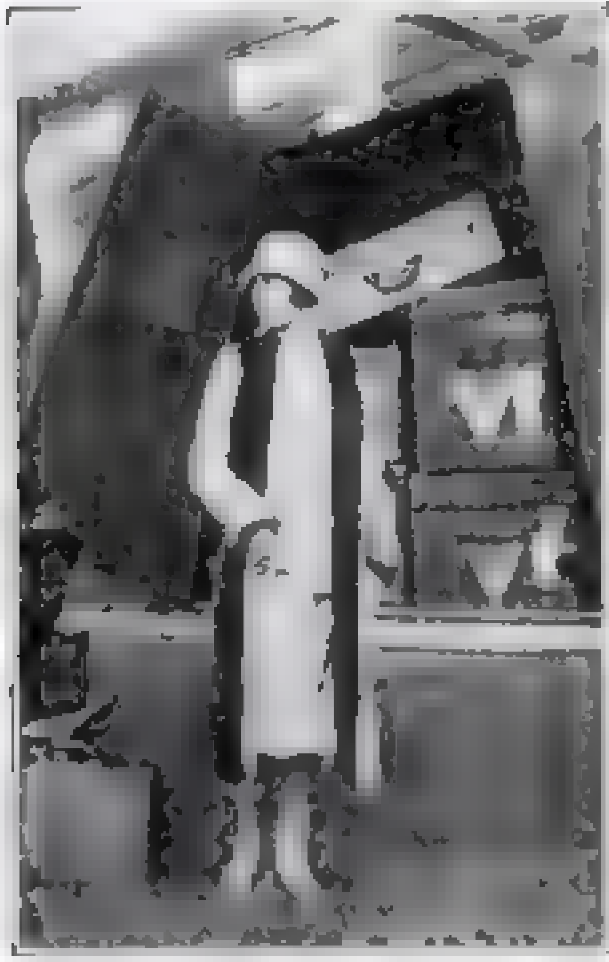


No better illustration that the day of the passenger air liner has arrived and is at hand can be found than in the luxury cabin of one of the ships in which the Graf Zeppelin makes its trips. Picture at left of an exploring party is typical

The finest railroad trains, even the best hotels, make no greater or more detailed provision for comfort of passengers and guests than does the metroplane of the Pan American Airways carrying passengers regularly between, Key West Fla. and Havana. It is equipped with three Wright engines

The cabin of one of the latest and most richly appointed airplanes in regular passenger service. The opened doors give an idea of the luxurious upholstery and attractive metal fittings of the interior. The seats are large and roomy and are not crowded. Far greater freedom for movement of both legs and body is allowed in fact than can be enjoyed in many theaters and in many uncrowded busses

AIRPLANE Passengers Can Dictate to Competent Stenographers, Enjoy Excellent Dining Service, and Sleep in Restful Beds in the Big New Planes



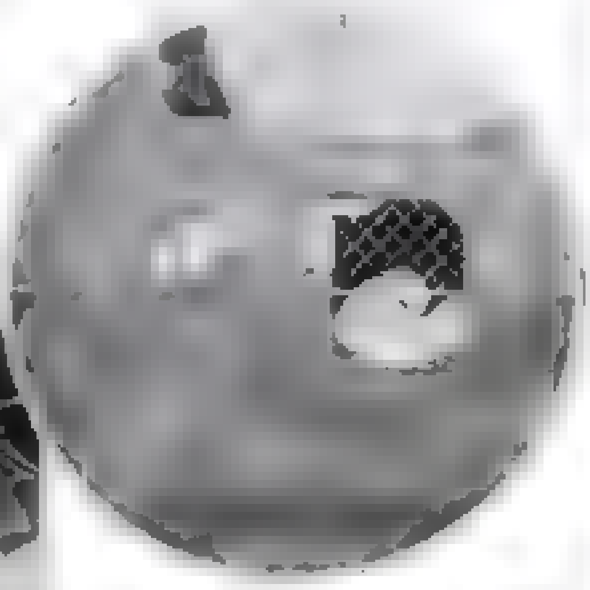
When a woman travels she usually takes a lot of luggage. For this, planes operating on schedules offer adequate accommodations

CAN air passengers [illegible]? The answer is given in these photographs. Not long ago a Middle Western [illegible] who had said he would never [illegible] a passenger plane because he [illegible] was persuaded to try [illegible]. He found it was like stopping at a metropolitan hotel. He ate, slept, played, and dictated letters to a stenographer. They had almost everything, we are told, except a swimming pool and a golf course. Perhaps the [illegible] is not so far in the future, if we judge from the comfort already achieved for passengers, as illustrated by these photographs.

So far only the dirigible [illegible] provides the promenade deck shown on the opposing page, but the increase in size of planes would make a forecast that they will eventually provide a similar aerial boardwalk seem entirely reasonable.

[illegible] of a berth in a [illegible] sleeping airplane whose exterior is illustrated below

Ten passengers recently had breakfast and published a newspaper in a F[illegible] plane above Los Angeles. A member of the party is showing [illegible] first edition of an air paper



O[illegible] view of a berth in a plane [illegible] long-distance [illegible] and [illegible] sleeping [illegible]. The [illegible] with a [illegible] with ventilation

The first call for dinner [illegible] express [illegible] passenger plane where meal service [illegible] hungry. A [illegible] is provided for each passenger [illegible] on the diminutive [illegible]

One of the largest German all-metal passenger planes, which has comfortable accommodations for fifteen passengers and three spacious compartments for carrying their luggage and mail and cargo

Romance with the Fishing Fleet

By Carl Helm

From the crow's nest of a fishing schooner the lookout sights a school of mackerel and signals his discovery. Instantly the ship is away to reach the fish and set the big seine

The deck of a small trawler awash with silver-gray mackerel, brought up in one haul of a large purse seine. Now the fish are to be carried on ice to the boat's near-by harbor

Between cruises the fishermen mend the great holes made in their nets by dogfish and other predatory fish which cost the industry tremendous losses

SCENE: An old fishing port off the coast of Cape Ann, on the rockbound coast of Massachusetts. Under a chilly moon in a freezing wind the women of the town line the docks and watch their men race against time and the ice—a gruelling spectacular contest.

All winter the port has been ice-bound. Now it's mid-March, and the fishing fleet is still locked in. But a westering wind at sundown drove the ice pack out beyond the point, and the harbor is clear to the ocean. Four hours, perhaps, before the pack comes piling back, closing the channel again. That would mean more weeks of waiting while the fish run thick to the south!

A strip of ice lies along shore. Less than 100 yards wide, it alone separates the fishing boats from open water. The fishermen crews, with axes and pikes, hack and chop at the imprisoning mass, to cut a path through to the open. For days their boats have been provisioned and fueled, awaiting this chance.

Now the men chop madly for the wind is changing. The watchers cheer. A last blow and shove—a narrow channel is clear. Crews jump for the gunwales and wriggle aboard. Motors cough and begin firing. The fleet is off. Gloucester men will be first to the fishing grounds!

Under the warm skies of June and July the months of ice-bound idleness will be forgotten as the men reap their harvest of silver-gray fish. The wharves of the old town of Gloucester, largest of American salt water fishing ports, will be piling high.

"MACKEREL!" To those of the prairie and farm and city that word may be nothing more than part of a familiar exclamation. But to generations of folk on the Massachusetts coast it has meant life and a living for some 300 years. Now it is more than a $1,000,000 annual industry.

The season begins about the middle of March, when the first hardy fishermen break through the ice and make to the southward where the fish are running. Then the rush begins, from Highland Light to Chatham, all up and down the coast.

The fishing fleets may be gone for weeks and months, following the great schools of mackerel. In the early parts of the season the catches are "run fresh" into the ports; but when it gets hot the mackerel are usually cured aboard the vessels and packed in barrels until the boats make harbor.

The season reaches its height in July and August. During the record run of 1926, arrivals of mackerel in Boston and Gloucester totaled 750,000 to more than a million pounds daily. Crews worked day and night, putting the fish under salt.

About 100 vessels, "a hundred sail," as the fishermen say, of various types, are engaged in the fishing season out of Gloucester and near-by ports.

Most exciting is the life of the purse seining fleet. A big net of light, tarred twine is fitted on the boat bottom with small lead weights to sink it quickly. Tied to the top are cork floats, to keep the "head" above water. Around the "foot" and rove through many iron rings so that it will work easily is the purse-line, a rope to draw the seine together like a bag.

The ordinary mackerel seine is about 1,350 feet long and 108 feet deep. It is set from a seine boat, a large whale-boat of distinctive Gloucester design. One end of the seine is thrown over the side and picked up by a man in a dory, who rows only enough to keep a fixed position in the water. The crew of the seine boat rows in a circle, paying out the seine. When they are back to the man in the dory he passes his end of the purse-line into the seine boat, and both ends are made fast to a "purser," which draws the bottom of the seine together. Thus makes a great bag which holds the fish tightly.

THEN the fishing vessel itself comes alongside the seine. One end of the net is secured to the rail of the vessel, while the seine boat holds up the other. A "pocket" is formed, from which the fish are bailed out onto the deck of the vessel.

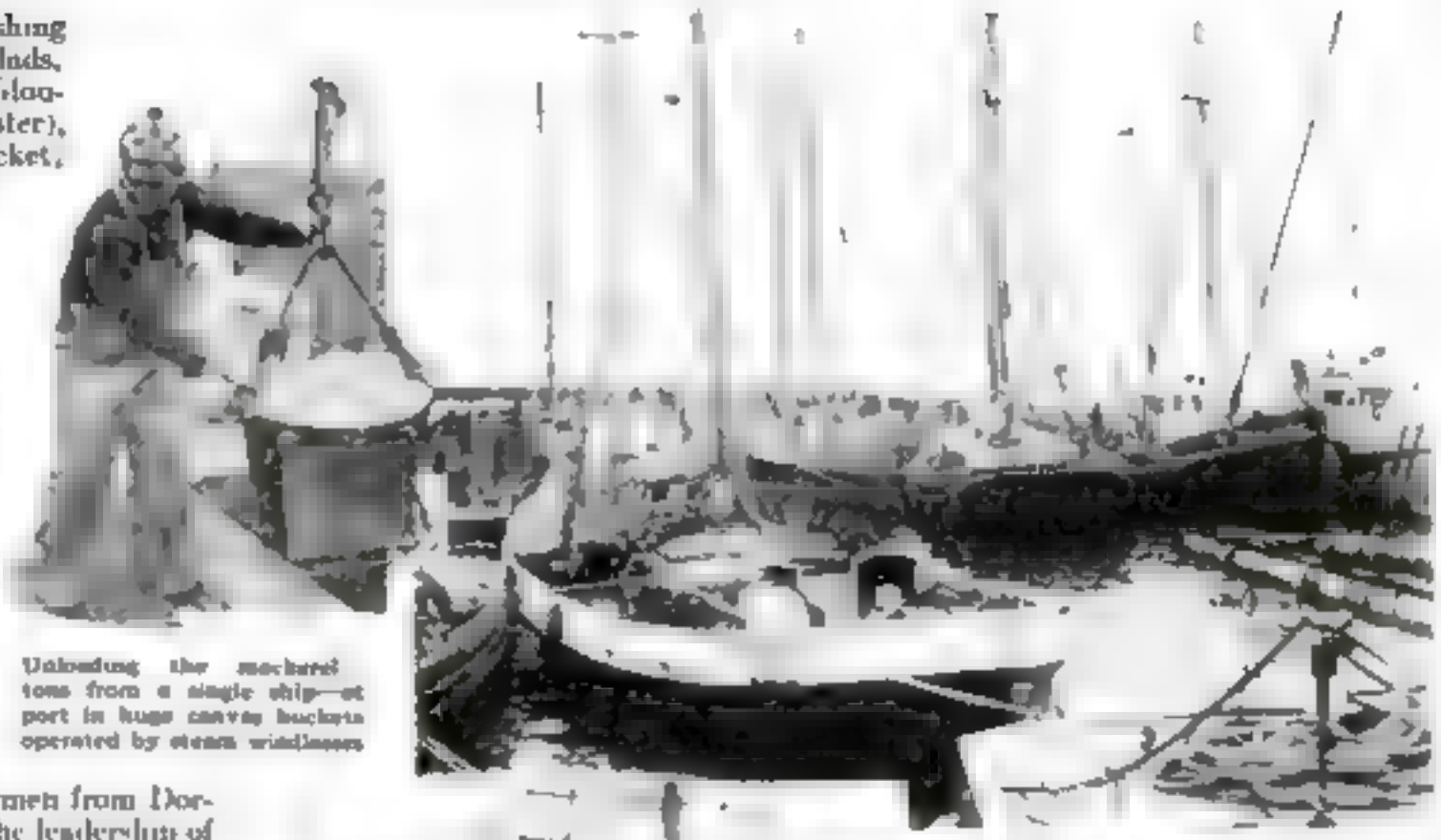
Gill-netting is a much simpler process. The gill-nets are small weighted seines strung out on a line to remain several hours, sometimes all day or night. The fish, enmeshed in the nets by their gills, are picked out and thrown into bins on the boats. The gill-nets average 180 feet long and eighteen feet deep, and resemble huge tennis nets.

Romantic are the names of old ports

and grounds of the fishing fleet, inspiration of ballads, yarns and chanteys! Gloucester (pronounced Gloster), Provincetown and Nantucket, Martha's Vineyard, Buzzard's Bay; Essex and Ipswich and Nahant, Cuttyhunk, Barnstable, Cape Cod! The names of the fish have a delectable tang, with ale-wives, flounders and pollock, menhaden, scup and sea-herring, squeteague, squid and tautog. The natty schooners fly names such as *Ingomar*, *Stiletto*, *Avon*, *Lark*, *Good Luck*, and *Sea Rover*.

Gloucester was founded in 1623, three years after the landing of the Pilgrim Fathers, by fishermen from Dorchester, England, under the leadership of the Rev. John White, a Puritan minister. The settlement became the Massachusetts Bay Colony some time later.

In the fall of their first year the fishermen landed a great catch of cod and sailed for Spain, where cod brought high prices. Fourteen men remained behind to organize the new town of Gloucester into the first salt water fishing port of the New World.



Unloading the mackerel tons from a single ship—at port in huge canvas buckets operated by steam windlasses

A part of the mackerel fleet in a Massachusetts port waiting word that mackerel have reached the region. Nets and other gear are piled on decks, ready for action. Most of these are modern craft with gasoline engines and sails for auxiliary power

IN THE three hundred years of its history Gloucester has seen its fishermen go forth to range the waters from the Capes of Virginia to Greenland and Iceland. The favorite fishing grounds of the Gloucester fleet are the Channel and Georges Bank, off the Massachusetts coast; Brown's Bank, La Have, Western and Quereau, 60 to 80 miles off the coast of Nova Scotia; St. Pierre, Green and Grand Banks, 70 to 90 miles off the coast of Newfoundland. The various banks of the Gulf of St. Lawrence are frequently fished.

Even the scientists who gave the mackerel the lyrical name of *scomber scombus* and trace his ancestry, admit their ignorance of whence he comes to the banks, and whither he goes. This much is known. Mackerel appear off the Chesapeake Bay-Cape Hatteras region anywhere from March 20 to April 20, and proceed up the coast until they are abundant even in Nova Scotian waters. Then, along in October, they vanish. Old skippers quote old Captain Sol Jacobat: "Mackerel have fins and tails, so they can come and go as they please. That's all I know about 'em!"

Hardship, adventure, and a gambling chance of rich reward is the lot of the men "who go down to the sea in ships" and have "business in great waters." Storms and fogs and rocky reefs have taken a toll of some 8,000 lives since Gloucester was founded. Even the present-day fleet, with modern engines and radio storm warnings, has its portion of perils.

The denizens of the deep seem to conspire, at times, against the fishermen. Several species of small, fierce sharks and swordfish rip up their nets, and kill or liberate their hard-won catches. Raids of the dogfish alone cost Massachusetts coast fishermen $500,000 a year.

The swordfish presumably migrates yearly from its breeding ground in the warm Mediterranean to arrive off the New England coast when the fat mackerel are running. It darts on its prey and with its elongated proboscis or "sword" wounds its victims.

The purse seine, 108 feet deep, has just been set in a great circle around the school of mackerel. Now it will be closed at the bottom like a purse and the fish captured. Above: Back in port after a cruise, all hands turn to with the land workers to pack the mackerel haul in barrels of salt or ice for shipment to the market

OUT through the ice at the first winds of spring the sturdy fishing boats go. Out into the harbor, past Norman's Woe, the hazardous reef immortalized by Longfellow in "The Wreck of the Hesperus." At the extreme southern tip of Cape Ann there is a weathered rock formation that resembles the figure of a plump old woman. The fishermen call it "Old Mother Ann." Bound out to sea, they throw her a kiss of good luck and farewell. She will be the first to greet them on their return.

DICK BYRD—Adventurer

Under the midnight sun, amid 10,000 miles of desolation, the bold flyers winged their way northward to the Pole

By FITZHUGH GREEN

Over the Top of the World with Brave Floyd Bennett — A Thrilling Story of Loyal Friendship You'll Never Forget

Congratulating the victor. Roald Amundsen greets Commander Byrd (left) on his safe return to base at Spitzbergen

NOT long after the World War ended the head of a large business said to Dick Byrd: "I'll give you $25,000 a year salary and a long-term contract if you'll come and work for me. Pick any department you like. What I mostly want you to do is to meet some of the important people on our list and go abroad once or twice a year. All expenses paid, of course."

Byrd shook his head. "Not yet," he replied.

"Why not?"

"Because I still have some exploring to do."

Whereupon Dick unrolled a chart and showed the business man some of the things left for the scientific traveler to do on this globe of ours.

He pointed out vast areas in the Polar Sea and on the Antarctic continent never seen by human eyes.

"Well, what of it?" broke in the skeptic.

Byrd smiled.

"Abstractly, sir, all knowledge is worth getting. Concretely, two things first, if we could solve the mystery of the origin of storms at either pole we should achieve the greatest scientific feat of the age; second, if we could locate a fairly pure deposit of any one of the rare earths we should give American industry the greatest single material boost it has ever had."

He then went on in detail. He spoke of the search for oil-bearing sands and shales in the Arctic; of baffling tides and currents in the North Atlantic; of the age-old riddle of the Garden of Eden, some of the evidence to be found in Eskimo migrations, of the fascinating interrelations of radio, aurora borealis and terrestrial magnetism—a group which give us that agony we call "static", of glacial pressures, dead mastodons, Arctic hot-springs, the lost Norsemen of the fifteenth century, and a score of other things that science can tackle only when the explorer lifts the veil of bitter cold and darkness that hides the polar regions from mankind.

Landing the *Josephine Ford* at Spitzbergen. On a raft constructed of boats and timbers the big plane was rowed and pushed through the drifting floes of the harbor

But the route Dick Byrd had to travel to his goal was long and devious.

HE HAD a battle to fight at home before he could open his now famous campaign for conquering the Arctic by air. In April, 1923, he banded with a group of young naval aviators to save aviation as a branch of the Navy.

For some time there had been a clamor for a separate Air Force. Certain influences had tried to wrest from the Army and the Navy all control of American airplanes, and center this control in a distinct military organization entirely separate from both services.

The climax came with a Congressional investigation. Sparks flew. Byrd appeared, brought one or two of his fellow flyers for witnesses, and boldly told some of the "inside facts."

A certain self-styled "aviation expert" had been removed from his post in Europe for incompetency. Dick Byrd saw that this point was made plain to those present. Ironically, the "expert" was a member of the committee!

"You're a liar!" shouted the Congressman, springing to his feet. *"And a coward!"*

Members of the committee leaned forward, tense, ready to jump between the angry man and the young naval officer at whom he was hurling his epithets.

FOR a long moment the ticking of a clock was the only sound that could be heard in the crowded room. Then the chairman turned to Dick Byrd and said

"Lieutenant Byrd, what is your side of the matter?"

With his usual calmness and simplicity, and ignoring personalities, Byrd rose and started to speak.

"For forty centuries, sir, there have been two great objectives in war: ships and cities. Ships are defended and attacked by other ships, cities by armies. A city can be bombed, but cannot be captured by aircraft. An army must be there to take it. Ships can be bombed from the air, but they and their men can be taken only by other ships."

Byrd paused and glanced along the stony faces of the professional politicians.

"Gentlemen, until there is a third objective, no reason for a third military department exists."

Brief, direct, simple. He sat down. There was scattered applause in the ranks of the spectators. The poker faces of the legislators revealed nothing. Dick Byrd [illegible] of the Air was surrounded by a mass dark and sullen.

Three years in all Byrd fought. In 1925 the victory was won finally over the advocates of a separate Air Force. A Bureau of Aeronautics meanwhile had been established by law in the Navy Department. And Admiral Moffett, Byrd's best friend, was made head of the Navy's Air Force.

Dick Byrd had been fighting for a principle on one hand, and a dream on the other. The dream was to regain the crown of geographical and scientific research which the U. S. Navy had worn for more than half a century ending at the Spanish-American War. Byrd saw how now the Navy's prestige might be built anew in the eyes of the world through exploration by air.

"Millions of square miles left on the globe north of our own continent," he told one admiral after another, "and almost none of it seen by human eyes."

His listeners shrugged their gold-embossed shoulders.

"I think I can base on Etah, North Greenland and fly northwest into the unknown area of the Polar Sea above Alaska. If I find new land there it may prove a valuable air base in the transpolar air route which is bound to come. This base should belong to the United States."

"THERE are bad storms," the admirals reminded him. "Peary met temperatures as low as sixty-five degrees below zero. You will wreck your plane if you are forced down on the ice."

"There is always danger in exploration," was Byrd's retort. "I believe we shall have a fair chance. And it's in line with naval duty to further geographical knowledge of the globe."

In ten days he won eight admirals to his way of thinking.

He tackled the Secretary. "Sounds all right," responded Mr. Wilbur, "but the President will have to decide."

At the White House, Secretary Wilbur put the case to Mr. Coolidge.

"There is still a lot of blank space on the map, Mr. President. This young officer has shown that he is a fighter. I will vouch for his being a flyer of the greatest ability. Don't you think we ought to let him go?"

Mr. Coolidge, as usual, had said nothing. But he had studied Byrd's keen face, firm mouth, and far-seeing eyes. After what seemed an endless silence he said

"Why not?"

That was March, 1925. Another triumph—but only a moral one, many material needs had to be filled before the President's approval could be turned into results.

For instance, at nine A.M. on April 2, 1925, Dick Byrd sat in the anteroom of a New York millionaire's office.

When every minute counted in the race to the top of the world! On the frozen shore of King's Bay Byrd and his men worked without halt in the bitter cold, loading the big monoplane with fuel. After a heart-breaking struggle the huge plane was finally ready

IN 1897 a balloonist named Andrée rose from the snows of Spitzbergen, taking the desperate chance that the wind would carry him over the North Pole. He drifted beyond the white peaks to the north and was never seen again. Only an Eskimo legend remains telling of a white man who came riding a boat out of the sky and disappeared.

Rising from the same spot twenty-nine years later, a monoplane carrying two men headed north over those same peaks. What happened afterwards is told on these pages.

The difference between Andrée drifting helplessly and depending on luck, and Byrd, able to speed along a carefully charted course, is dramatic. It is a difference produced by thirty years of human thinking.

Above: Commander Byrd seated using his sextant, [illegible] with which he fixed the position of his plane in the [illegible] Polar Sea and established [illegible] he had reached the Pole. Right: One of the amphibian planes in which Byrd and his men flew 6,000 miles in their 1925 Arctic trip

"I have a letter of introduction," he told the secretary who had come out to see him, hopefully. The letter was from an old friend of the rich man.

"Mr. B— will see you presently," the secretary replied.

Hour after hour Byrd sat. After the struggle and excitement of Congress, after his trying weeks among the admirals, it was almost beyond his power of patience to have to play the part of a beggar.

Noon came; one o'clock, two.

"Doesn't Mr. B— eat lunch?" Byrd asked the secretary.

THE minion grinned. "Oh yes. He's eating now. Went out a side door."

Mortified, Byrd himself went for a sandwich. In fifteen minutes he returned to his weary vigil.

At five-thirty P.M. a colored messenger came and told him Mr. B— was sorry but he was "too busy to talk about exploration."

In succeeding days, chagrin of that failure was repeated over and over. "Too busy to talk about exploration," became a stock phrase.

"It began to look much like my other years," Dick told me not long ago. "Like the time when I had to retire just when I was going strong; like the time I had to stay put just when I was going to fly the Atlantic, and again when I had to see my friends die, just as I was going to bring the *ZR-1* back. Now my big dream of an Arctic air trip was going to smash after I had done the hardest part by getting the Navy and the President on my side. And all for want of a few dollars!"

But tenaciously he fought on. Then Edsel Ford and John D. Rockefeller, Jr., awake to the possibilities of air transportation, took a fancy to the earnest young officer. Both gave $15,000, making the expedition possible.

AT LAST, on June 20, 1925, Byrd sailed from Wiscasset, Maine, aboard the S. S. *Peary*. He had three amphibian planes, capable of flying from land or sea, and a handful of picked pilots and mechanics, among whom was one destined to mean much in the life of the leader.

That man was Floyd Bennett, whose brilliant career as a pilot came to an untimely end a few weeks ago, as he was carrying aid to the *Bremen* flyers, stranded at Greenly Island. A silent, blue-eyed young mariner, whose tastes ran to cams and valves rather than to blocks and tackle, Bennett's courage and ability at once won the admiration of Byrd, and the two became close friends and comrades in adventure. Their friendship began in this manner.

On the 3,000-mile jaunt north the *Peary* ran into a nasty gale that lasted a week. Heavy seas smothered her; wind tore down among her spars and rigging, and the combination finally loosened her precious deck cargo of crated plane wings and bodies.

Byrd called his men together, such as were not prostrated by seasickness, and told them that the ship might as well go home if the planes were wrecked or washed overboard.

"Let's lash them to the mast!" exclaimed Bennett.

Byrd turned to the fellow. "It's a dangerous business. If you don't go over the side you'll be smashed when the crate lifts and slams down again."

But Bennett was already into his oilskins and halfway up the hatch. Through a black night and howling wind he led the rescue work. His courage and superhuman efforts, aided by a dozen other good men, saved the day.

Birdmen of the Arctic. Byrd and his dauntless pilot, Floyd Bennett (shaking hands), and other members of the polar expedition, standing beside their plane

Left: How Byrd's plane was shod with skis. For the take-off, a long white runway was built across a snowy field

That was the man who later piloted Byrd to the North Pole, and who, when stricken by pneumonia this year, was preparing to fly with him to the South Pole.

On August 1, late afternoon, the *Peary* dropped anchor in the little harbor of Etah, North Greenland. On each side loomed high cliffs that framed a huge glacier at their eastern end. Behind spread the ice-filled waters of Smith Sound. On a small tongue of land inshore were three brown smears, skin tents of the native Eskimos.

At five-thirty next morning Byrd and his men set to work. For seventy-two hours the party labored to get a plane into the air.

ONLY Byrd's happy optimism kept the party from giving up then and there. For it turned out there was no beach on which to work, no floating ice on which to stand, no calm weather to permit assembly. And day and night it snowed or poured rain, or the fiord was blanketed with fog.

Icebergs drifted in and tore at the planes moored to the ship. Cold numbed the fingers of suffering mechanics. One plane caught fire and was so badly damaged that it could not be used again. A gale roared down from the Greenland ice cap and nearly swept the *Peary* from her anchorage. Precious carrier pigeons, for use in case of forced landing, were loosed only to be cruelly eaten by wild Arctic falcons.

A serious knock developed in two of the motors. The airplane skis proved of useless design. Water was found in the gasoline. One strong man, nerves worn raw by constant toil, grew mutinous and for a few hours threatened Byrd's control of the situation.

IT IS to the leader's credit that when the others discovered the true facts they rallied around him with a loyalty death could not break.

On August 5, though all hands were well-nigh exhausted, Byrd ordered the first test flights. Eskimos lined the shore, still not believing that the big motor boat, as they called it, would fly.

Suddenly the engine began to roar. The plane darted across the harbor, then rose into the air.

"*Ah-h-h!*" exclaimed the Eskimos in unison. They could not believe their eyes.

"Byrd is a great spirit!" cried the Chief, old Sipsu.

Next day Byrd and Bennett hopped off for Ellesmere Land, the ice-shrouded mountainous land which lay between him and their goal, in the Polar Sea.

As they sailed along they came down to within a few feet of the sea

(*Continued on page 181*)

Perilous moments in the drifting ice—carrying the *Josephine Ford* to the shore at Spitsbergen on small boats. A change in tide or wind would have swept the whole outfit to sea

Barium solution fills the patient's appendix, intensifying its shadow on the screen. The shape of the appendix indicates whether it is diseased

I Can *Peer into Your* Stomach and Foretell Your *Future*

By I. Seth Hirsch, M.D. *In Collaboration with* Boyden Sparkes

THE man walked into my office keenly alive, flashed a quick glance at his wrist watch, and asked permission to use my telephone before the examination I was to make of his stomach. Because I had to shield my eyes behind dark goggles for five minutes or so to acquire "cat's eyes"—enlarged pupils sensitive even to feeble gleams of light—I told him to take his time. Testily he retorted that he was too busy for that and began to pick off his cravat with one hand as he lifted the telephone receiver with the other. Then I heard him speaking to one I assume was his wife.

"I've chartered the McLean houseboat for next winter," he said with a surprising gaiety into the mouthpiece of the telephone. "We'll fish and read and play for a couple of months in Florida."

Fifteen minutes later, when he stood stripped to the waist, bracketed between my Roentgen ray machine and a fluoroscopic screen, I could have told him he was mistaken as to where he would spend the next winter. A shadow on that screen cast by a malignant growth within his rib basket foretold his doom. The abstraction called time that he was frequently trying to measure with glances at his wrist watch was before long to have no meaning for him. He was going to die—soon.

Often I get from shadows on that screen such starkly tragic glimpses of the future of the people who stand between me and the powerful, invisible rays. Fortunately, I see with most patients reflections that tell me how their lives can be prolonged. Once not so long ago, it was a little girl pitifully thin racked by a cough that ordinary remedies had not helped. She appeared to be dying. How easily the X rays must have passed through that fragile attic mortal! But there was one spot where they could not pass, a place in her gullet that showed on the screen as a round, black shadow. It was a penny this child had swallowed. With forceps that followed the same path through her mouth and made an equally black shadow on the screen the corroding coin was removed. My records of the case end with the satisfying notation "Uneventful recovery."

STORIES of ancient miracles, in which a handful of dust becomes a legion of armed soldiers or a tree turns into a man, leave you skeptical.

"But the miracles of today, those of science such as Dr. Hirsch tells you about on this page, find no scoffers. We almost take for granted the wonders of modern invention. Some even go so far as to look forward to perfect machines that will supplant man as master of the earth.

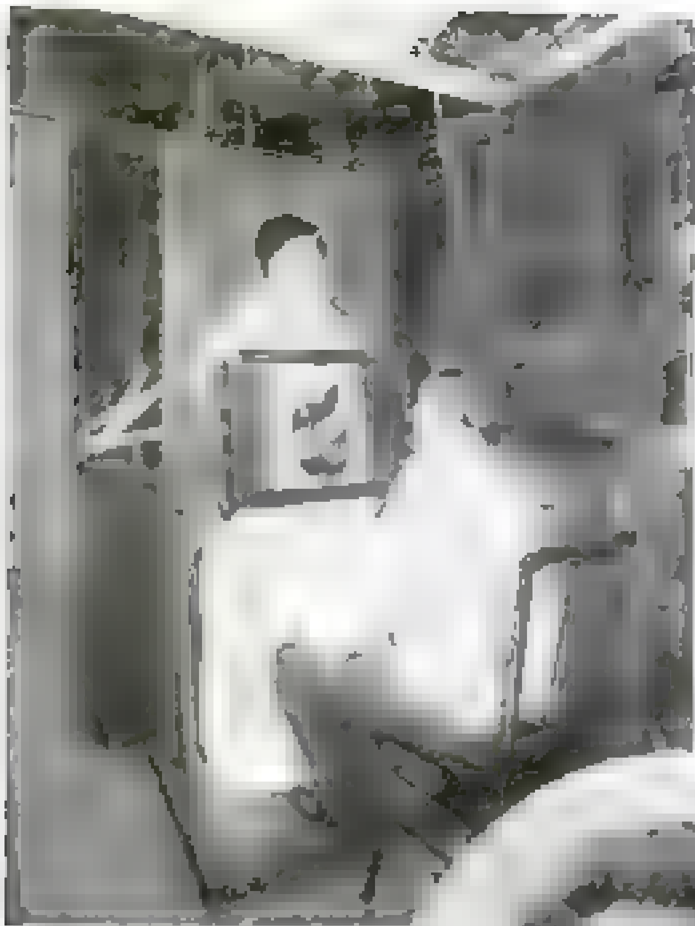
"But they forget that no machine has imagination or judgment and that no machine learns by experience.

"An automobile would sit in the garage forever if there were no intelligence to step on the starter or guide the wheel. The X-ray, with all its thrilling possibilities, is useless until a Dr. Hirsch, or some other skilled scientist, interprets what it shows.

"Back of the machine, man is master!

THERE is no easy magic in the skill of a physician but the X-ray in conjunction with the photographic plate and fluoroscope screen has made even the practitioner of little or commonplace ability an extraordinarily capable individual as compared with the best of doctors of the period, say, of the Civil War.

The normal stay-at-home man is still thrilled by the exploratory achievements of navigators of sea and air. We



To the expert these shadows of the patient's vital organs indicate their condition of disease or health

William Conrad Roentgen who [illegible] discovered X-rays

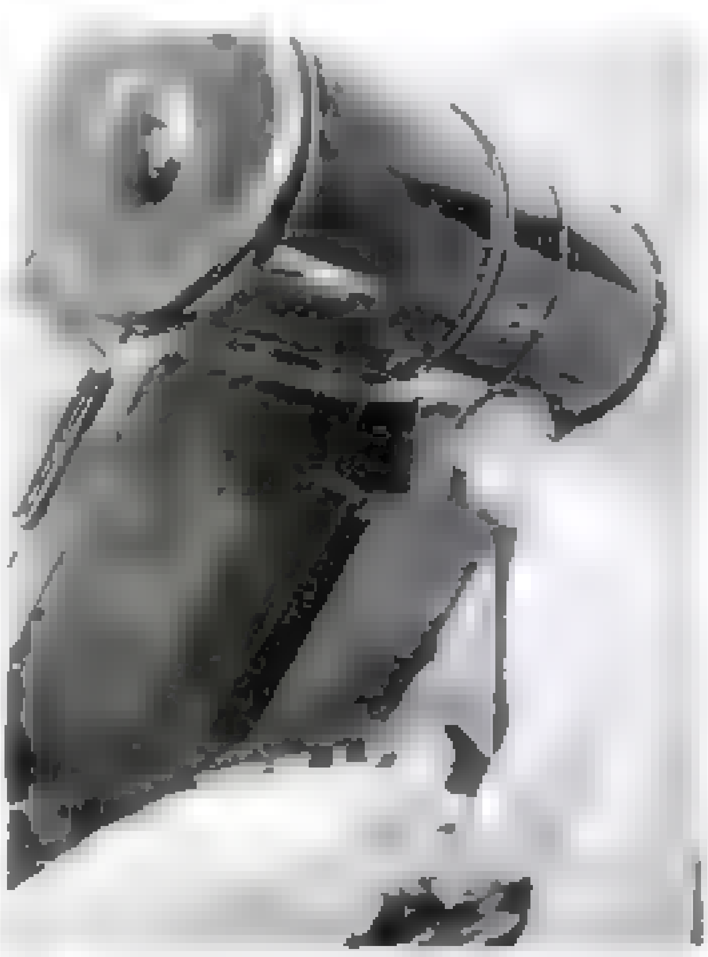
[illegible] the birthday of [illegible] Peary, Shackleton, Greeley, Stanley, Balboa, Magellan are well remembered. But who can name the first man in this country to look at the inside of a living being, see his heart pumping blood, and observe other amazing movements of the organs within the human body? I, myself, almost have to ponder to recall that it was a Dr. Williams of Massachusetts General Hospital, Boston; but it is no effort for me to remember the mental giant who made it possible. His name has been taken by my branch of the medical profession. We call ourselves Roentgenologists, and he was William Conrad Roentgen.

It was late in the spring of 1895, in a room filled with scientific apparatus in the Institute of Physics in the ancient German town of Wurzburg, that the discovery was made. Roentgen, tall and heavily bearded, was standing in deep thought before a glass bulb glowing with colored light. He was carrying on the hunt pursued so slowly and painstakingly by Plucker, Gassiot, Geissler, Hittdorf, Varley, Crookes, Leonard, and before them all, Faraday—to discover the meaning of Nature's fundamental mysteries, of electricity—of material substance, the master problem of the universe.

In the vacuum tube, energized by the current of an induction coil, the riddle was, it seemed, seeking to unfold itself to the mind of man. Geisser had been the first to pass the induced current through a tube of low vacuum and then to marvel at the gorgeous color as of daybreak sunlight on the waters of the sea. Hittdorf had discovered the cathode ray therein; Crookes had noted the change in the [illegible] the vacuum was in- [illegible] Hertz's profoundly [illegible]stion, Leonard had [illegible] the cathode stream out of [illegible] studied it. Now, with [illegible] of findings seething [illegible] Roentgen, Professor of [illegible] University of Wurzburg, [illegible] on the meaning of [illegible]ping color. He noted [illegible] fluorescence of the glass [illegible] as Plucker had done [illegible] years before; he remembered [illegible] designation of "ra[illegible]" as that influence which [illegible] emanated from the neg[illegible].

IF IN [illegible] this you choose to call [illegible] an accident I am [illegible] I do not see it as an accident, but as an example of the extraordinary power of the developed human imagination to form a bridge across unthinkably vast spaces of ignorance, over which other minds less powerful may troop on further explorations.

Absorbed in thought, Roentgen, when called from the room, laid the still glowing bulb on a book within which a large, flat antique key of iron served as a bookmark. The book itself rested on a photographic plate holder which Roentgen had prepared for an afternoon outdoors at his hobby—photography. On his excursion he used the plate in that holder. Developing it, he found the image of that old key, superimposed as a blotch of shadow on the picture he had planned to take. And that shadow was to make Roentgen the creditor of mankind.



The 250,000-volt X-ray machine of the Research Hospital, Chicago, one of the largest, shown in operation

HOW came that image there? The fogging of photographic plates in the proximity of energized vacuum tubes had been noted before, but to Roentgen's mind, this was a challenge. What precious bit of knowledge was this that tantalized him?

Roentgen let nothing interfere with his investigations until he had discovered the mysterious agent which had so silently recorded its presence and its power. He began by repeating the experiment he had first performed by chance. With pounding heart he saw on a second plate the shadow of that key. He dared to dream then of what was almost scientific heresy—invisible light.

Noting the green fluorescence of the glass of the Crookes tube, he conceived the idea that other substances might be similarly affected. Fluorescence is the property of certain bodies when illuminated of giving light of a color differing from their own and from that of the surrounding light.

Roentgen shrouded his tube with a light-proof envelope, so that no faint glimmer of its flickering was visible to his eyes, and then in a totally—to human eyes—dark room he made another discovery! A handful of platinobarium cyanide that appeared in the ordinary light of day as so much salt glowed in that dark room with a strange, opalescent fire. Then he understood. A ray invisible to his own eyes, a ray which penetrated solid substances, had pierced the shroud inclosing the tube and illumined those salts!

THESE were unknown rays, and so he gave to them the designation of X-rays. Even at a distance of nine feet from the tube the salts fluoresced brilliantly green, as if he held a handful of fireflies. It was then that the first X-ray photograph with a medical portent was made. Roentgen placed his hand on a covered photographic plate, energized the Crookes tube above it, and obtained a photograph of the shadows of the bones.

One of those who were quickly aware of the significance of Roentgen's discovery was Thomas A. Edison, who then devised a hood and screen that made it possible for doctors to see the shadows of a living human anatomy standing in the path of those invisible agents from a Crookes tube. Edison analyzed and experimented with eighty substances before selecting one as being the most sensitive and fluorescent when exposed to X-rays. The hood was something like those with which cameras are focused. With it, or one fashioned like it, Dr. Williams was first to see the inside of a living man!

Before that only a few incidents had given physicians any visual knowledge of what goes on in a living human body.

In early American times a Dr. Beaumont in St. Louis peeked with wondering (Continued on page 111)

How Silent Policemen Work

A Graphic Description of the New Manless System of Traffic Control

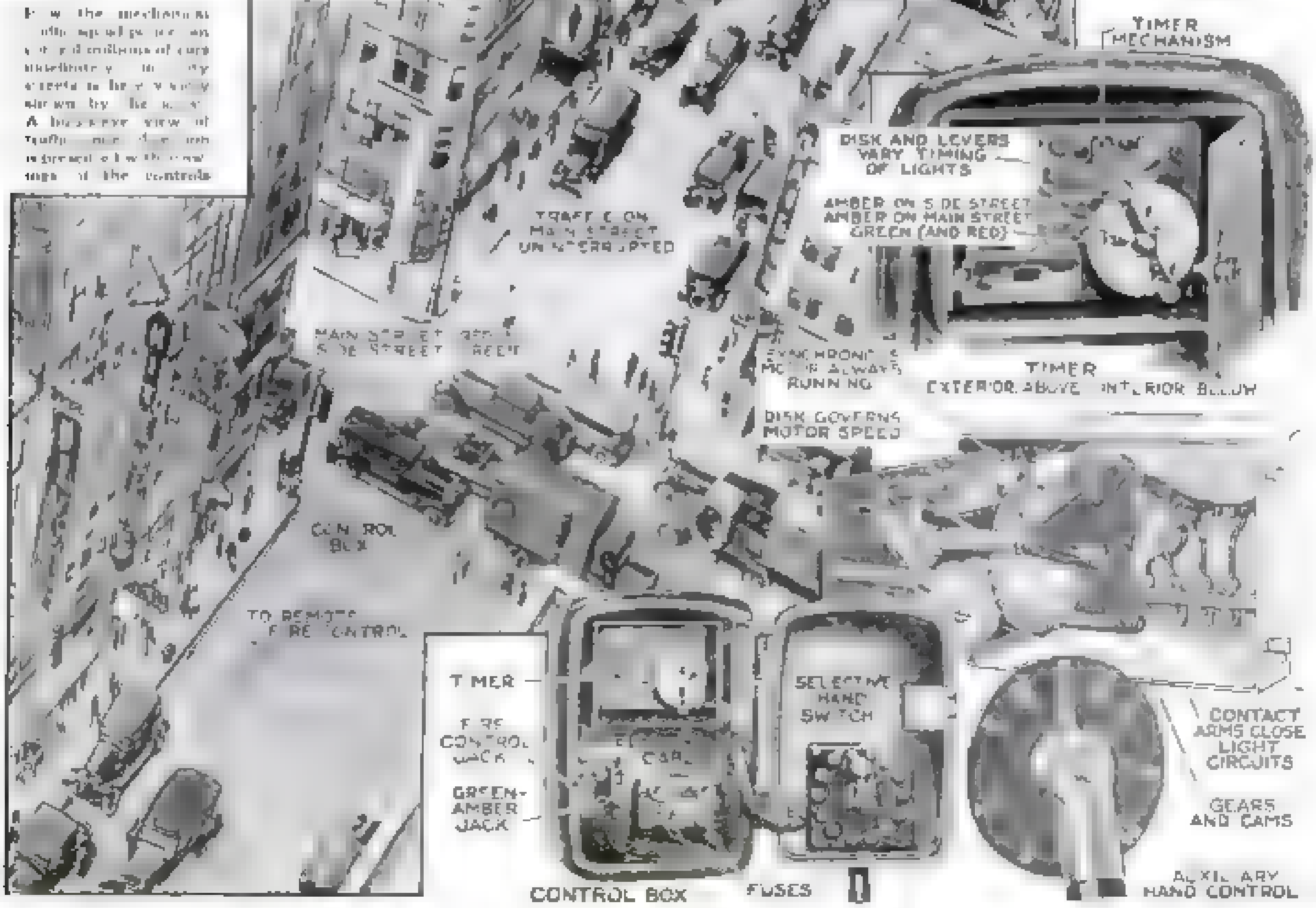
HOW do the blinking red and green lights that stop traffic or send it speeding on its way really work? On this page our artist [illegible] the latest and most ingenious types of traffic signals [illegible] by the General Electric Company and now in use in sections of New York City, Chicago, St. Louis and other cities.

Such a system will direct traffic [illegible] without [illegible] intervention by any human hand. Within the control box at each intersection a synchronous motor flashes the lights on main and side streets with unflagging regularity. One signal may allow two minutes for uptown and one for cross traffic; a signal a block away may employ a different proportion, for each intersection is a separate traffic problem in itself.

All signals along a street may be set to flash red or green in unison, a necessary arrangement in extremely dense traffic. Where lighter traffic permits, another arrangement of signals permits uninterrupted flow of traffic. Side street traffic crosses between the flocks of cars [illegible] main street [illegible]. Amber lights [illegible] are about to change.

In case of fire, remote control from headquarters through a jack in the control box turns all lights red to permit safe passage of fire engines. At a central office an operator [illegible] buttons can stop all traffic [illegible] street or on all.

How the mechanism [illegible] signals [illegible] millions of cars [illegible] streets is [illegible] shown by the artist. A bird's-eye view of traffic [illegible] interrupted [illegible] the controls



Flyers *Who Rob* Caterpillar Club

In this plane Vance Breese landed safely with seven passengers at San Francisco recently after his propeller and engine were shaken out when 1,200 feet in air

Breath-Taking Escapes of Aviators Who, Face to Face with Death, Piloted Crippled and Burning Planes to Earth; How Their Amazing Skill Has Made Flying Safer for Everyone

By NELL RAY CLARKE

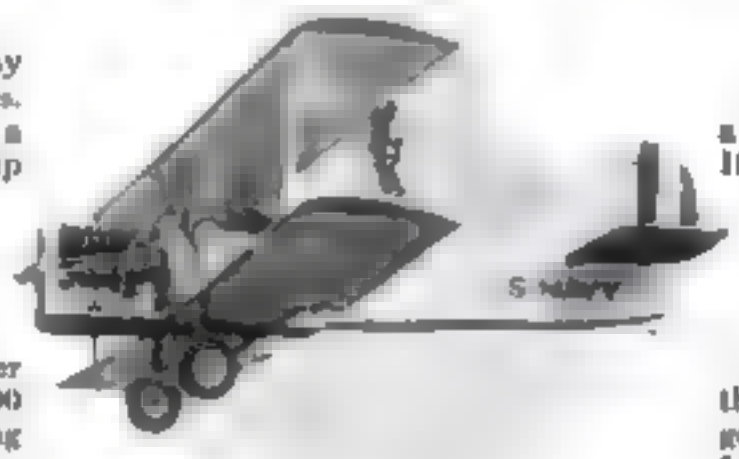
HIGH in the air the big Army bomber burst into flames. Lashed to the fuselage was a ton of explosives. The ship hung for a second, then plunged in a dive, fire whipping back from its disabled engine.

Lieutenant Eugene L. Eubank had taken up the huge plane with a full load of torpedoes for a test flight over Wright Field, at Dayton, O. At 9,400 feet the motor had overheated. Long streamers of flame shot out.

Three hundred feet from the ground Test Observer Gene A. Althoff jumped. His parachute caught on the tail skid and ripped, though it saved him.

Lieutenant Eubank yanked the controls, flattened the wings, laid the blazing plane down on the ground gently, and crawled out cursing his luck.

The Caterpillar Club, mythical organization of pilots and passengers who have saved their necks by emergency parachute jumps, had been cheated of a member—for Eubank had every reason to seek safety in the oaken folds of the caterpillar's spinning.



A Navy demonstration of an initiation into the Caterpillar Club. A jump photographed just before the parachute opened. Below, Floating gently to the earth

"CHEATING the Caterpillar Club" has become a favorite sport of the hardy airmen, as their skill has increased and as planes have become increasingly dependable. While Army and Navy officials look with disfavor upon a pilot who uses his 'chute a little too often, they do not, however, encourage untoward heroics. Still the annals of aviation are full of thrilling accounts of airmen who have "stuck to the ship."

Just a few weeks ago a Navy flyer robbed the parachute club of five new members in one fine piece of piloting. Chief Aviation Pilot Peter N. Anschutz was flying in connection with battle-fleet maneuvers off San Diego, Calif. At 6,400 feet he let out a "sleeve" target for antiaircraft guns. It fouled a propeller and a blade was carried away. A whirling fragment wrecked the starboard engine, which tore half loose from its mountings and hung dangerously. The four observers the plane carried got ready to jump, but Anschutz said he would stick and they stuck with him. The pilot couldn't get the ship to head downward, so the four observers crawled forward to weight down the nose.

ANSCHUTZ cut off his good motor lest it ignite the gas that the wrecked one was spilling, and brought down his ship in a long graceful glide on a stretch of water alongside a battleship. Boats from the dreadnaughts rescued all. Somewhat similar was the more recent experience of Vance Breese, commercial aviator, over San Francisco, with seven passengers, including a woman and a child. Twelve hundred feet up the propeller flew off, the vibration ripped the engine out of the frame, and the ship went into a sideslip.

Breese, burned by scalding oil, brought the lurching plane out of a spin, ordered his passengers forward in the cabin to balance it, and brought it down in a series of glides. His safe landing was little short of miraculous.

By far the most spectacular fight against fire in the air was that waged by Lieut. C. C. Champion in his try for a world's altitude record last summer. Facing almost certain death, he refused to take to the parachute because that would have disqualified his height record.

Almost seven miles up the cylinder heads blew out. Flames leaped from the engine. He threw the plane into a sideslip, and blew the fire out for a moment. A nose dive extinguished it

again. The third time the fire started, licking back toward him and the precious instruments that recorded his height. Another sideslip and again the rushing wind fanned out the flames.

On the Navy air field at Anacostia, D. C., observers saw the plane falling like a comet, a tail of fire and smoke streaking behind it, and summoned ambulances. They saw the ship right itself, straighten out, and land in a cornfield. Champion stepped out, clutching his altitude instruments.

ON SUCH a record flight as that, Major R. W. Schroeder, former holder of the world's altitude laurels, fell three miles like a plummet. Four miles up, in bitterest cold, the air man's eyes were almost frozen in their sockets. He lost consciousness, and his plane dove. A mile above ground he regained his senses, grabbed for the stick, and made a good landing. He failed to make a new altitude record, but he hung one up for the longest fall ever made by a human being who lived to tell it.

Landbergh, Chamberlin, the late Bennett, and Byrd have made emergency landings of great skill and daring.

Lindy is an "ace" in the Caterpillar Club. Four different times he took to the 'chute when his vision was banded by fog or snow. On one of his last regular Air Mail flights he was 150 feet up when his throttle snapped. Lindy "put her nose down" and picked out an open clover field and such was his skill that he landed unhurt.

A few weeks before he took the great *Columbia* across the Atlantic, Clarence Chamberlin performed one of the most expert and audacious landing maneuvers in the history of aviation.

The big monoplane had just been christened by a happy nine-year-old girl, and she and her little chum and John Carisi, factory superintendent of the Bellanca designers, went up with Chamberlin. The ship took a nasty bounce on the take-off and soared up with the left strut and landing wheel hanging useless. The watchers knew that if Chamberlin, unaware, tried to land, the plane would crack up, probably killing everyone in it.

Grabbing a loose landing wheel from a hangar truck, a brother pilot flew up and around the *Columbia*, waving the loose wheel and pointing to the *Columbia's* damaged landing gear. Chamberlin thought he understood, but to make sure Carisi crawled over Chamberlin's lap, and while the pilot held onto his legs, hung head downward under the fuselage to inspect the damage, then scrambled back.

THE pilot decided he must find a long clear field to maneuver and land in. Curtiss Field, from which he had taken off, was overrun with people. He headed for Roosevelt Field, but to his dismay he saw people swarming to it, sensing the impending tragedy.

Another pilot with the words "land at Mitchel" chalked on the side of his plane swooped up beside Chamberlin.

Ambulances were already waiting there as Chamberlin circled Mitchel Field, losing height, gradually settling down. Thirty feet from the ground he threw the plane up on the left, then dropped her. The sound right landing wheel hit the ground—the right wing tip scraped the grass and thus, while men and women covered their eyes, the big plane taxied along in perfect balance for 200 feet. Then it heeled around sharply and stopped.

Chamberlin jumped out and lifted out the little girls.

"Thank you, Mr. Chamberlin. We had a nice ride!" they courteously.

Marcel Richard, plucky French mechanic of a passenger plane carrying twelve people from London to Paris, had a harrowing experience when the throttle broke on the starboard engine. The engine roared out of control, and the plane began rocking crazily. Richard staked his way out on the wing in the blast of a seventy-five-mile wind, gripped the brace wires with one hand, and with the other held the broken throttle and controlled the engine for half an hour until his pilot could find a good place to land.

TWO brave flying lieutenants cheated the Caterpillars when they refused to jump and desert helpless companions. Lieut. William R. Sweeley, of the Army Air Service, was flying with an observer when his motor went dead. The terrified man refused to jump, so Sweeley chose to take the chance with him. He went into a glide, began throwing overboard everything loose to lighten the shock of landing, and headed for a thick forest. At the tops of the trees he pulled the plane to a stalled landing. The wings remained in the tree tops, while the fuselage crashed to the ground. Lieutenant Sweeley was severely injured, but the observer escaped with a broken ankle!

Lieutenant D. S. Cornwell, U. S. Navy, and Lieutenant E. B. Curtiss, his passenger, were flying over Hampton Roads, Va., when, 2,000 feet up, a wing buckled and broke. The plane shot down like a rock. Cornwell was ready to jump when he saw that Curtiss was caught fast in the cockpit. Cornwell managed to slow the plunge with the good wing, but Curtiss was killed. The brave pilot lived, despite his injuries.

Another nervy airman from the Hampton Roads field stuck to his plane in an almost incredible adventure. Lieut. Commander Isaac

Continued on page 134

Pilot C. J. Warren's plane goes into a side drift at Los Angeles and he and four passengers cheat the Caterpillar Club by landing on another plane

"FROM Dan to Beersheba" was synonymous with illimitable distance in Bible times. It was exactly 139 miles! A racing airplane would zip over that distance while you are walking a few blocks to work.

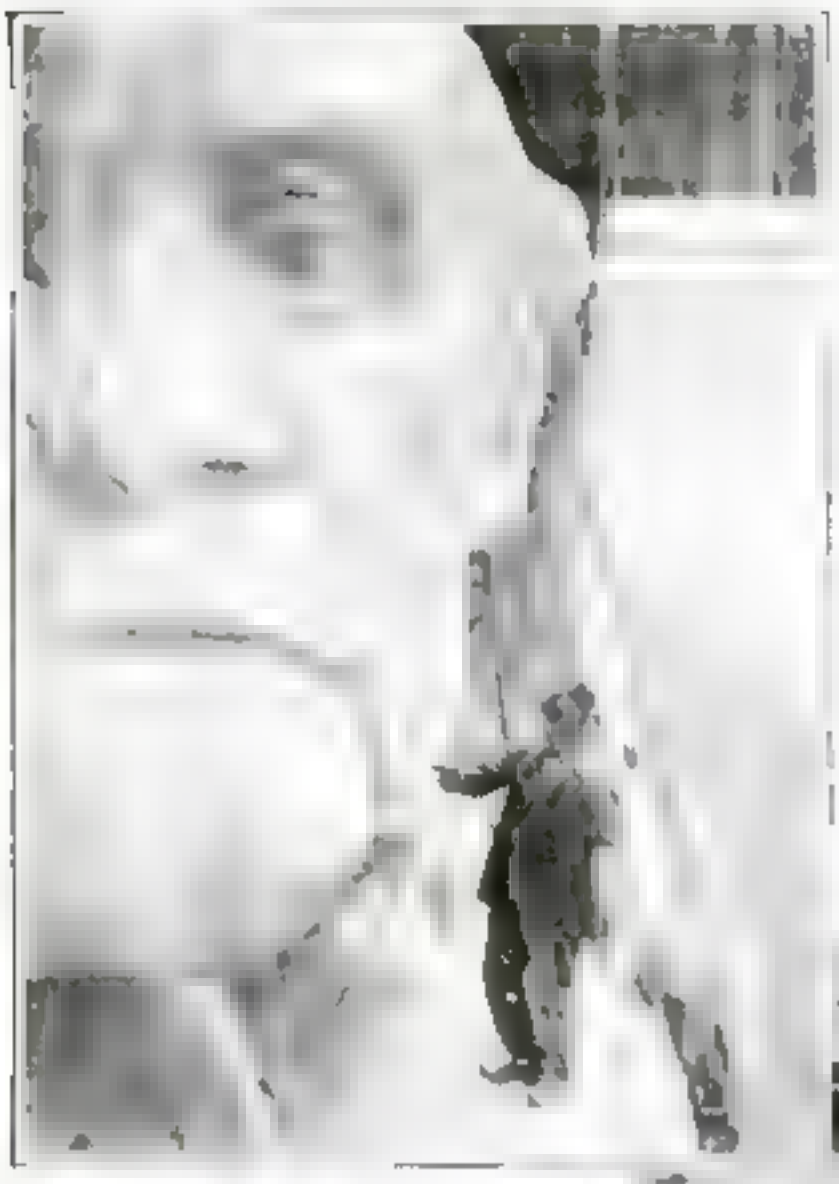
In one generation we have come from the horse and buggy to the 200-mile-an-hour automobile and the 350-mile-an-hour airplane. Modes of travel standard since the days of the Hittites disappeared overnight.

In this achievement, the "dare-devil" played a big rôle. From his skidding turns and bursting tires on the early speedways, and his "spiral dips" and "death drops" in the air, inventors gained the knowledge that brought the modern automobile and is making flying safe for all.

Without the spirit of the chance-takers, whose thrilling escapes are related in this article, science would progress only so far, and then stop.

Clarence Chamberlin, by maneuvering of consummate skill lands his damaged trans-Atlantic plane on one wheel, averting a tragic end for the flight in which he was carrying the ship's little girl sponsor and her chum. Pilot and passengers were uninjured

Mountain *Carved into* Monument



Unveiling of Confederate Memorial Shows How Scientific Genius Made the Face of 800-Foot Cliff into Camera Plate for the World's Greatest Photograph

By GEORGE LEE DOWD, JR.

Thousands of whip-driven slaves labored throughout a king's lifetime to erect the Great Pyramid of the Nile. A single sculptor with a hundred assistants is creating the Stone Mountain monument. His slaves are pneumatic drills of iron and steel. Imprisoned air is their driver.

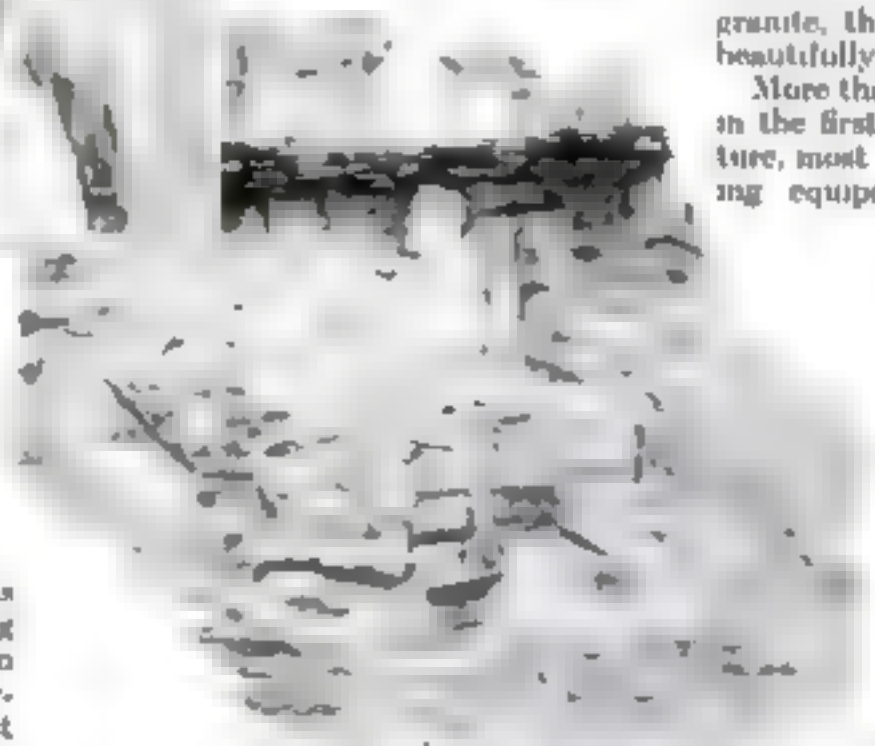
The site was dedicated by the United Daughters of the Confederacy, whose vision and loyalty have made the memorial possible, on May 21, 1916. It is a weather-smoothed, dome-shaped mass of granite, three miles in circumference, in beautifully wooded country near Atlanta.

More than $600,000 has been expended in the first workings on the great sculpture, most of it in assembling and installing equipment. About $200,000 was spent by the famous sculptor Gutzon Borglum, who started the work. When he resigned his commission he had just finished the head of Gen. Robert E. Lee and outlined the figures of "Stonewall" Jackson and of the horses the two were riding.

Three years later Augustus Lukeman, Southern-born sculptor, known for his works in the Brooklyn Institute and

(*Continued on page 127*)

Clustering by itself some details in the gigantic head of Gen. Lee in the Stone Mountain frieze. Below: General view of the figure of Lee on his horse Traveler. The famous horse measures 175 feet from head to tail. The Southern commander's overcoat buttons are as large as half-bushel baskets. The stone comprising the part of scabbard below the saddle blanket alone weighs sixty tons

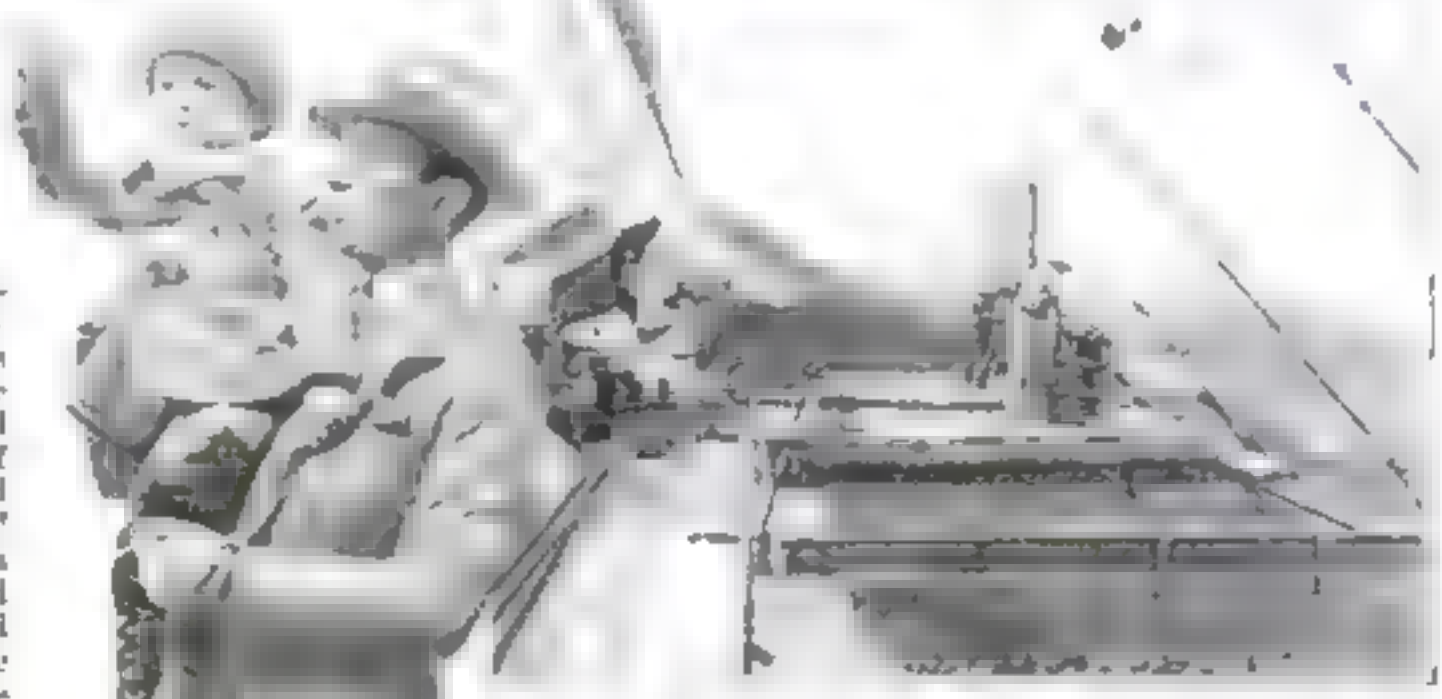


IN THE heart of old Dixie there was enacted a few weeks ago a soul-stirring scene that symbolized the unity of the North and South and exemplified the capacity of man for gigantic intellectual and scientific achievements born of patriotic inspiration.

In Georgia of the old South there was unveiled the first completed sculpturing of the colossal memorial being graved on the face of Stone Mountain to perpetuate for posterity the gallant "Lost Cause." And the smiling and dapper Mayor of the North, a New York official, participated in the ceremonies.

Here in everlasting granite is being carved the most magnificent memorial in the world—a mammoth frieze depicting heroic figures of the Confederacy's leaders, astride their mounts, reviewing the gray-clad hosts who march before them. The famed Pyramid of Cheops would be lost beside it. The Sphinx of Gizeh is not so high as the head of one horse in its vast design.

The sculptor's medium is a great façade 800 feet high and 3,000 feet long, a single solid rock, unblemished by time. The finished memorial—it will take several years to complete it—will represent an engineering as well as an artistic achievement of the first order.

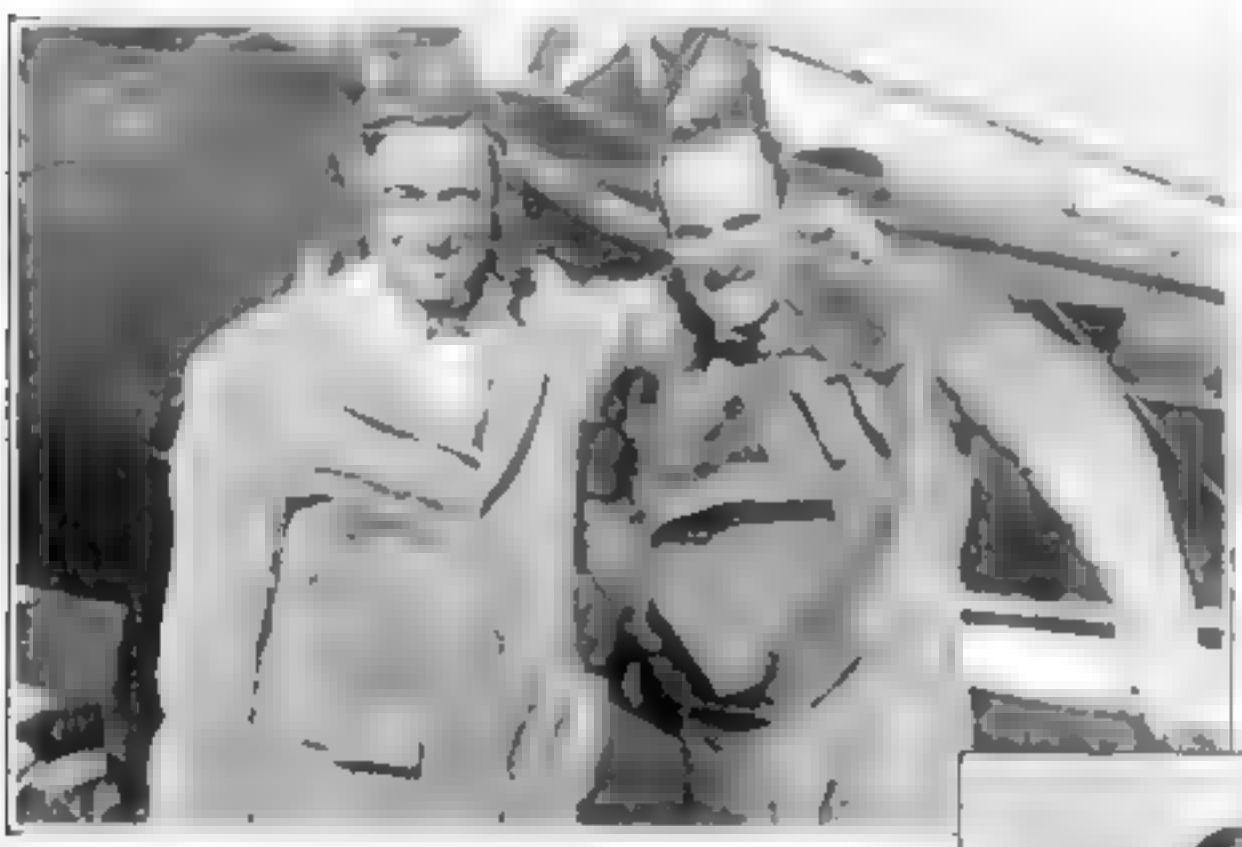


Along the top of the Stone Mountain cliff, 800 feet high, is an immense trestle from which are suspended by steel cables the scaffolds on which the sculptors of the huge frieze work. Left: Mayor James J. Walker of New York City, who, on behalf of the Nation, accepted the memorial, holding Robert E. Lee IV, who gave the signal for the unveiling of the sculptured head of his great grandsire

Breaking Into Aviation

America's Foremost Pilots, Engineers and Airplane Manufacturers Tell How They Won Success and How You Can Start Your Career

By EDGAR C. WHEELER



Will Rogers, famous cowboy comedian (left), with "Casey" Jones, veteran pilot, who built planes "out of work" into a $200,000 a year air taxi service

DUDLEY M. STEELE had just received his discharge from the Army Air Service. He was sitting in the Kansas City Athletic Club, one day in 1919, reading a newspaper, and wondering now and then who'd be to get a job.

At a table across from him sat Ilos Nafziger, head of a large Kansas City wholesale baking company.

Presently the pilot spotted an advertisement of an airplane for sale and called Nafziger's attention to it with a jest.

"Hey, why don't you buy an airplane and use it to advertise your business?"

Nafziger was no mincing man. "I'll buy it, if you'll fly it," he replied.

It was a bargain. The baker bought the plane and Steele flew it for a year to eight branch baking plants in Missouri, Illinois, Iowa, Oklahoma, and Texas. The business suddenly received unwonted publicity.

Today the former pilot holds a high executive position in the aviation department of a California oil company for which incidentally he gave up a business paying $9,000 a year—all from proving advertising a profitable branch of aviation.

That is one pilot's own story of how he broke into the business of aviation.

The new [illegible] camera with [illegible] and [illegible] the head of the [illegible] from the air

Courtesy Fairchild Aerial Camera Corp.

Many young men, when they talk of "getting into aviation," think of the business as consisting chiefly of piloting an airplane. As a matter of fact, eighty percent of the successful flyers who are telling the readers of POPULAR SCIENCE MONTHLY how they began declare emphatically that to them piloting in itself is not the ultimate goal; rather it is a stepping stone to positions of larger responsibility in a spectacularly growing industry.

They say that aviation is advancing so rapidly and becoming so complex that, like any other thriving business or [illegible] now calls for specialized [illegible] and specialized endeavor.

[illegible] with the flyers recalled how [illegible] new [illegible] wings and learned to fly [illegible] they reveal how they have used their flying knowledge to advance to [illegible] of leadership.

Right now, they say, the great need is for [illegible] executives to direct and [illegible] the many phases of aviation development. And here is the largest opportunity.

In this connection a word of sound advice comes from Burdette S. Wright, until recently the director of flying training at the Army Air Corps Advance School at Kelly Field, Texas.

"I would like to suggest that men do not take the attitude that piloting alone is a profession," he said. "Aviation is a growing organization, and those young men who get into it with background other than merely pilot training will succeed. This background should be either engineering education or some education with reference to organization and administration. If this attitude is taken, it will prevent so many boys from leaving school when they are seventeen or eighteen years old and going into aviation before they have a proper background to develop into higher positions. At Kelly Field I saw many boys fall by the wayside because some background was needed beyond enthusiasm for pilot work. The companies of the future will want pilots of well-rounded judgment, resourcefulness, and education."

TO THIS P. R. Love, an Army school graduate now in the airport construction business at St. Louis, Mo., added:

"The first thing for the young man to do is analyze his own ability to adapt himself to some particular phase of the industry. In the years to come, when the design of airplanes advances to the point where it will not take such highly trained personnel to operate them, pilots will

The air mail, a whole profession and business in itself, has many high executive posts with former pilots and will have many more to fill

right. It is a better investment to buy 100 hours of dual instruction than ten hours of dual instruction and an airplane.

An aerial salesman with an unusually spectacular career is the man who, as sales manager for the Ryan Airlines in California, landed the order for the *Spirit of St. Louis* from Col. Charles A. Lindbergh. He is A. J. Edwards, at present sales manager for the Prudden-San Diego Airplane Company.

Edwards began "playing with aviation" back in 1911 when, as an automobile race driver, he engaged in thrilling automobile-airplane races with noted flyers. His greatest contest was with Lincoln Beachy in 1912.

Later Edwards purchased a plane and employed a pilot to teach him, but an

Saving cotton fields from the boll weevil, the work that gave a start to Marion Street of Detroit and many others now successful in aviation. The flyer is dusting Texas fields with calcium-arsenic fatal to the pests. This method, used in various parts of the country against various pests, has saved hundreds of thousands of dollars in crops

become more than flyers. Piloting should be regarded as a means to an end: to furnish experience for the next step forward.

Just what are these larger opportunities?

An answer is found in the surprising variety of responsible positions the trained flyers occupy today. Many have organized their own commercial companies and aviation schools. Some are manufacturing and designing planes. A large group includes company executives and officials in the Government service. Then there are company test pilots, Air Mail pilots, flying instructors, aerial salesmen, sales managers, and photographers.

A typical example is Harry Rogers, of the Rogers' Air Lines, who last month told how he learned to fly while serving as a mechanic for a private owner and who later enlisted in the Naval Air Service.

One of the fleet of planes of the Western Air Express, which aviators with business and executive ability built up

"ON LEAVING Naval aviation," he continued, "I immediately went with a newly formed commercial company as chief pilot, and I flew and managed their boats over several established lines. I got the job because they needed a man with experience as an organizer for their operating force. We built up a real efficient force. Leaving them, I organized my own company."

C. S. "Casey" Jones, a pioneer pilot in commercial service, confesses that he was perhaps more fortunate than others. "It happened that the connection I made was a good one. Upon my resignation from the Army, I obtained a position with the Curtiss company with which I have been ever since. They had airplanes available without any particular use for them, and I formed an operating company doing a sort of commercial taxi service. This company grew rapidly, operating a flying school, doing considerable aerial photography, and engaging in aviation taxi service, both local and cross-country. This company was started in the summer of 1919, and has grown steadily, so that in 1927 we flew over 350,000 miles and did a gross flying business of around $500,000."

Again, here is a group of flyers who made good as aerial salesmen—for instance, J. A. McInaney, vice president in charge of sales of the Alexander Aircraft Company of Denver.

"In 1925 I was assistant sales manager of the Alexander Film Company," he said, "and J. Don Alexander conceived the idea of having some of our hundred salesmen use airplanes in their work. I persuaded him to let me go to a flying school in Missouri, buy a ship, and bring it back to Denver, which I did with twelve hours' instruction.

"As the altitude here is more than five thousand feet above sea level, and as the ship was under-powered, and as I was extremely green at flying, the next two months offered amusement to spectators, thrills for me, and repair bills for the firm. We decided to build our own ship, ideal for this altitude, hence the Eaglerock. Then it was decided to enter the airplane manufacturing business, and I was made sales manager of the Alexander Aircraft Company, now producing three ships a day and building a factory at Colorado Springs with a capacity for one ship an hour."

THE chief pilot of the same company, Cloyd Clevenger, a former Army pilot, got into the business through connection with an airplane sales agency. "I obtained the job," he explained, "by harassing the agency. I believe that is still a good system—but first, learn to fly

injury received in racing barred him from a commission in the Air Service. In 1926 he went to San Diego as salesman for the Ryan company.

"DURING the two months we were constructing his plane," said Edwards, "Colonel Lindbergh lived with me. Most of his planning and preparation was done in my apartment. Sitting under the guns of the publicity of Colonel Lindbergh's wonderful flight for eight months gave me a most definite view of the world market for airplanes. I was able, last year, to sell almost $400,000 worth of machines over my desk with but one trip into the field.

"In 1926, we had the choice of men who had knowledge of aviation and none of business, or with full knowledge of business and none of aviation. But 1927 changed this condition and attracted to aviation many men with business ability who are carefully learning the fundamentals of aviation.

"Regardless of what a man wants to do in aviation, he should take up flying so that he may know the air problems and the air language. He need not continue as a pilot."

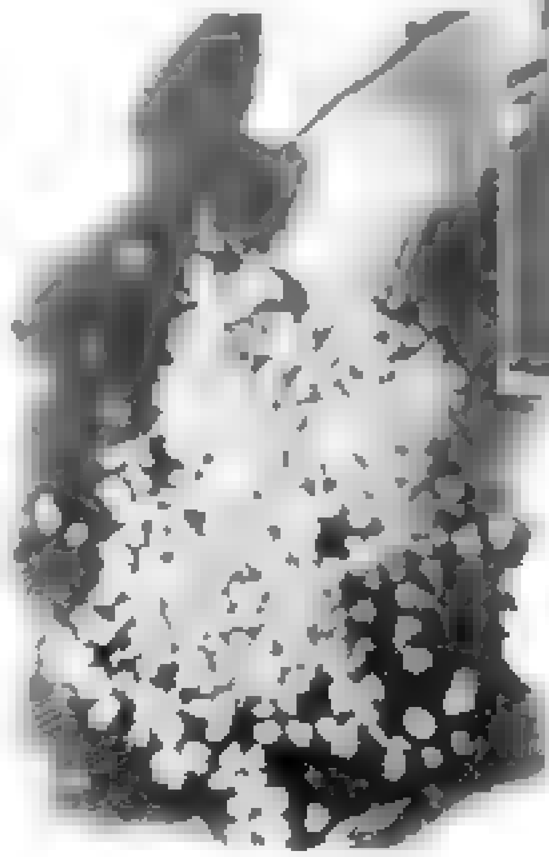
John P. Wood, (Continued on page 133)

New Wealth from Magic Sand

Amazing Uses Found for "Silica Gel," a Wonder Product of the Laboratory

BY WALTER E. BURTON

Prof. W. A. Patrick, of Johns Hopkins [illegible]



AS SIMPLE and ordinary a thing as sand, invested with almost magic qualities and endowed with amazing powers by the tireless research and experiment of the laboratories, was called upon for aid in raising the sunken submarine S-4 when the United States Navy encountered difficulties that threatened seriously to delay the lifting of the doomed ship with her forty heroic dead.

But for the strange power of this substance to aid in the salvage work, the photograph of the ill-fated vessel once more afloat which appeared in the June POPULAR SCIENCE MONTHLY might not have been possible until weeks later.

When the lives of divers working about the craft were endangered by the freezing of moisture in their air lines, the ice choking them, someone happened to think of silica gel, the remarkable substance that, a short time before, had been put to work keeping the interiors of submarines dry by taking water vapor out of the air. A silica gel dryer was rushed to the scene and removed practically all traces of moisture from the air being pumped to the divers. Thus one more hazard was removed from the all too perilous business of diving.

AND it was removed by sand—chemically treated sand that is called silica gel because of its resemblance at one stage of its formation to gelatin. A laboratory curiosity for nearly a century, the strange substance has only recently been turned to practical service of man.

A single grain contains millions of pores so small that scientists believe them to be the spaces between the molecules that comprise the grain. The total area of the surfaces of these pores in a pound of the gel is about 450 acres. The usefulness of the material lies in the capacity of each pore to act as a capillary tube, sucking in water, alcohol, oil, and almost any other fluid, as well as vapors and gases, much as a blotter sucks in ink. Ten tons of the gel can take in four tons of water and still remain dry on the outside and not increase in volume!

Its action is called adsorption, different from absorption in that the adsorbed matter simply adheres to and does not enter into any chemical relation with the adsorbing substance. Adsorption, says one German scientist, will eventually rival electricity in importance in industry.

He may well be right. Already the harnessing of silica gel has become one of the many romances of modern science.

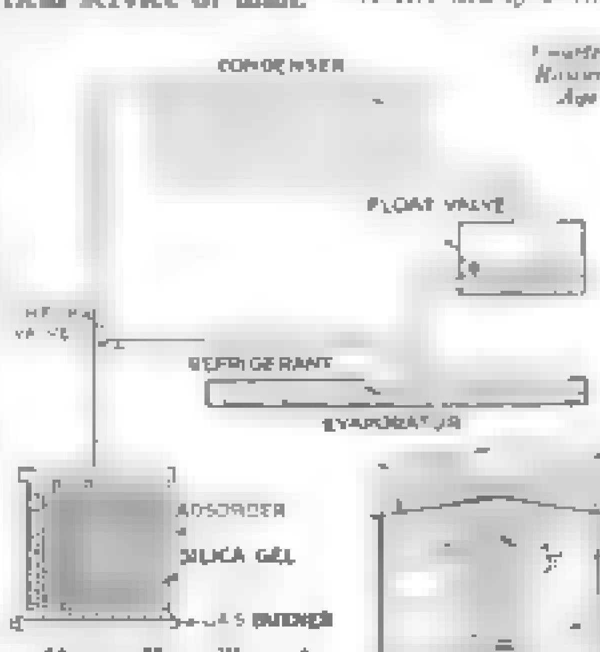
Just before the World War Dr. Walter A. Patrick, now Professor of Physical Chemistry at Johns Hopkins University, was studying for a doctor's degree at the University of Gottingen, Germany, under Dr. Szigmondy, inventor of the ultra-microscope and a world authority on colloid chemistry.

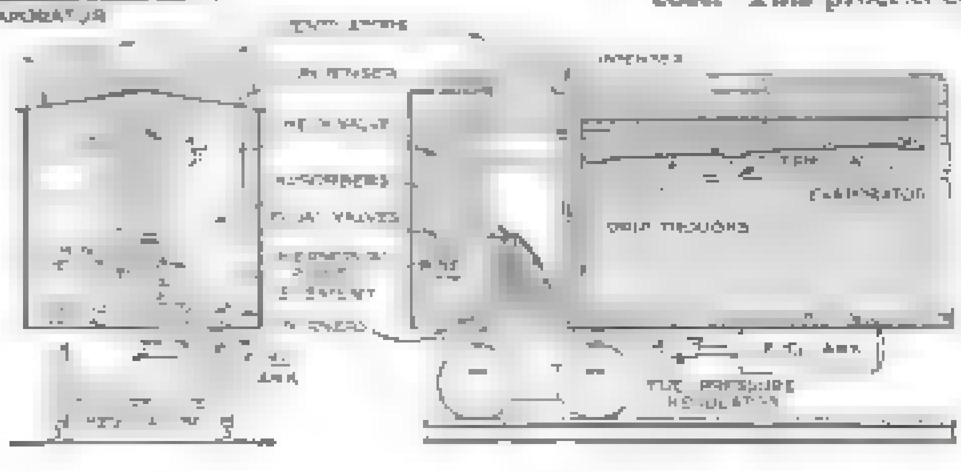
"Silica gel was first [illegible] by Thomas Graham [illegible]," Dr. Patrick said [illegible] the history of the substance. "While studying under Dr. Szigmondy, I found several new properties of the gel, and noticed it would adsorb many gases and liquid vapors.

"THE summer after the United States entered the war found me in Washington, a member of the U. S. Chemical Warfare Service, hard at work on the development of gas masks. After trials in other directions, the Government concentrated its efforts on charcoal, which was known to adsorb gases to a considerable degree. The chief difficulty lay in obtaining dense charcoal, and everyone remembers the campaigns to collect peach seeds, from which the best was made.

"One day I recalled my work on silica gel. We tested it in gas masks and it worked perfectly. But immediately we struck a snag. The silica gel could be made only in small quantities by a very complicated process called titration. After considerable experimenting I developed a simple method of manufacturing the gel in any quantity at a reasonable cost. This process consists essentially of heating clean sand with caustic soda and treating the resulting sodium silicate or "water glass" with sulphuric or hydrochloric acid. A jellylike mass is formed which, upon being broken

(Continued on page 127)





Above: How silica gel adsorbs evaporated refrigerant and, when heated, releases it for use again. Right: The system applied to a refrigerator car, using thermostat control

The Movie Maker

A Romance of Real Inventions

By S. W. NEWMEYER *Illustrated by* ERNEST FUHR

Latest of marvels in motion picture production is a scientific film, "Nature and Love," which unfolds on the screen the whole dramatic story of evolution. Beginning with the earth as a primeval swamp, it portrays the gradual development of life through the ages, the creation of man and woman, and the progress of mankind to the present day. From Edison's first moving picture to this new epic of the screen is a span of only thirty-odd years. Back of the elaborate film dramas we enjoy today are remarkable inventions and discoveries, many of whose secrets are revealed in this absorbing novel of the movies.—The Editor.

WAS that a crack in the ceiling or only a thin bar of sunlight? As Don's idly curious gaze followed the diagonal line across the ceiling and down the wall he realized with bewilderment that it wasn't his ceiling—nor his wall—nor his—yes, it *was* his Judy. For the girl sitting there in the queer high-backed chair, her eyes closed, her lips softly relaxed, was the only familiar thing in the room, with its blank cream-colored walls, its white enameled table and chest of drawers. Even the narrow iron bed in which he lay was strange to him.

Don let his eyes rove about the quiet room again—pink roses in a pitcher on the chest of drawers. A glass, with a spoon holding down its paper cover, on the white table in company with two or three bottles. The window shade was pulled down, but along its edge the sun made a bright lengthwise border. And in the room a hush—almost as though someone were dead.

But there was Judy, close beside his bed. He could see the gentle motion of her breathing. He felt a bit guilty staring at her so hard, a sleeping person looks so defenseless. But his eyes were hungry for a sight of her. It seemed months since he had seen her. She didn't look the same, somehow. Her dress, perhaps. Not the knickered riding suit, but a soft, woolly blue thing that open at the throat, gave her skin the cream white tint of a gardenia petal. Don shut his eyes and chuckled softly—he'd never dare tell Judy that. He knew her scorn for sentimentality.

A sudden rustle in the chair made him look up again. Judy was leaning toward him in alarm, her eyes wide and anxious. He smiled, made an attempt to sit up, and became sharply aware that his left arm was strapped against his side. Judy was out of her chair in an instant, bending over him restrainingly.

"You mustn't—" she began, then she looked at him beseechingly. "Oh, Don, you *do* know me this time, don't you?"

"Of course!" Don intended his voice should express surprise at such a foolish question, but it was unaccountably weak and his words trailed off in a whisper. "Couldn't be anybody but Judy. Wouldn't want you to be anybody but you."

At Judy's dimples dawned in a sudden radiant smile. And then she did a thing so strange that for the moment Don lost his breath. Bending over him, she dropped a small, swift kiss on his forehead.

"Now lie perfectly still and I'll call the nurse," she commanded, and whisked joyfully out of the room. But before she had closed the door memory flooded over Don and he called after her hoarsely.

"Jerry—what happened to Jerry?"

"Not a thing!" Judy looked back reassuringly. "He was hardly bruised."

* * *

Thin broth—and sleep. Thick broth, almost like mush—and more sleep. Soft-boiled eggs and toast. Then, feeling not at all drowsy, Don demanded extra pillows, sat up, and called for an accounting.

"I came to yesterday afternoon," he mused. "But when did we crash? Last Tuesday, wasn't it? What's today?"

"Friday, but—"

"Then I've been knocked out three days, haven't I?"

"The accident happened a week ago Tuesday."

"I'VE been away from the studio nearly two weeks?" Don's voice was sharp with unbelief. He strained higher in the bed, but eased himself as his collar bone gave him a twinge of pain.

"Now, Mr. Kennedy," his square, substantial nurse made a fractional adjustment of the bedclothes with firm, authoritative pats, "if you are going to excite yourself, we shall just have to wait till you are stronger before we talk about anything."

"I'll be good," grinned Don. "But if you don't tell me everything that's happened, I'll worry as hard as I can."

Miss Beyer's big square teeth showed for an instant in a large smile and she began briefly to tabulate the events of the previous ten days.

"Concussion of the brain, broken collar bone, delirious and sometimes so violent nobody could quiet you but Miss Burke—"

As the nurse talked on, assuring him that within a few days he would be up and out of the hospital, Don wondered just how much of his hidden thoughts he had revealed in those days of delirium. Whenever the nurse said "Miss Burke" and she brought Judy's name into her recital frequently, her eyes shone with a peculiar twinkle.

Judy had sent word that she would come in to see him the next afternoon, and Don determined to find out. Not even the progress of the picture seemed so important now. Rubbing his hand

Judy bending over him ... and at him beseechingly: "Oh, Don, you do know me this time, don't you?"

Don and Judy, young and shining and solemn, took their places within the curve of the bay window. Mr. [illegible] smiled benevolently on them from a little distance

thoughtfully over his chin, he was shocked to feel the young forest there. He called for a mirror, groaned, and demanded a barber.

Next afternoon, resplendent in haircut, shave, and gaudy borrowed bathrobe, he settled himself in the invalid chair to await his caller. It was the first time he had been out of bed, and as Miss Bever tucked a blanket over his knees she warned him that he could sit up for only an hour. She repeated her warning with emphasis when Judy entered a few moments later. Then—as I lag not too broadly—she tactfully withdrew.

SEATED primly in a small, straight chair near the window, Judy finally broke the prolonged silence.

"You don't look so much like an invalid today," she remarked.

"I don't feel at all like one except when I try to walk," Don replied. "And, by the way, a broken collar bone is not contagious. You might draw your chair nearer."

Judy made a valiant attempt to control her dimples, then she tilted her chin and laughed gaily. Don's hearty chuckle echoed her—for no reason at all except that there was a peculiar electric current in the air. A current that snapped and sparkled in Judy's eyes, that tingled in Don's finger tips.

"I think it did you good to have concussion of the brain," she commented as she moved her chair to a demure three feet from him, just beyond his reach. "I've never seen you so light-hearted."

"That's because of the medicine you gave me day before yesterday."

"Medicine?"

"A tonic, maybe. Anyway, I'd like to have the prescription filled again." He attempted to say it lightly, but his voice shook a little and his face was suddenly very solemn. He stretched out his hand to her. "Judy—I can't come any nearer you—do—do I have to get unconscious again before you will give me another kiss?"

* * *

The room was very quiet, though the broad shaft of sunlight flooding through the window quivered with brightness, and the fresh roses on the table poured out a living stream of fragrance. Then Judy caught her breath with a little flutter of laughter and straightened up on her perch on the arm of Don's chair.

"I've brought this back to you," she said, and handed him a long, legal looking envelope she had brought into the room with her.

Wonderingly he turned it over and read the typewritten inscription. "Last Will and Testament of Donald Kennedy."

"Where in the world did you get this?" he asked, astonished.

"You gave it to me when you were delirious," she explained. "You insisted on sending for the lawyer and then you made him hand this over to me. We couldn't satisfy you till it had been done. If anyone had known what was in your mind, we might have fooled you with any long envelope."

Don's arm tightened about her, then he slipped the envelope back into her hand.

"Might as well keep it, Judy. Dead or alive, the little that I have belongs to you. Though I hadn't intended to tell you till I had something to offer."

THERE was a moment of silence. Don looked up inquiringly just in time to catch a teardrop on his chin. Judy gulped and disengaged her hand long enough to dry her eyes.

"Don Kennedy," she quavered, "if you're waiting till you get rich before you ask me to marry you, you'd better say good bye now! If you don't want me when you're poor and need me, I won't have you when you're rich—and that's going to be very soon now."

Don laughed, but Judy bent an accusing gaze on him.

"If you only knew how many times you went over that when you were delirious!" she exclaimed. "It almost broke my heart to think you might die without ever knowing that I'd rather have you without a cent than—"

But by an ancient device not yet improved upon by any camera trickery Don made the rest of her sentence not only unnecessary but impossible.

Was it for his special benefit that Jerry threw all that ardor into the love scene? And Margaret was playing up to him very responsively. How long had Jerry been holding that kiss? "Break!" Don ordered

"Let me go," said Judy. "I must powder my nose before the nurse comes back."

But at a safe distance from Don she stood and smiled.

"Now for the surprise! Jerry has a customer who wants to buy a tenth share in your invention."

"How much is he willing to pay?" inquired Don cautiously

"Fifty thousand dollars."

"You're joking!"

"But you've often said your machine would be worth a million within a few years," replied Judy, quite unruffled

"Yes." Don stared at her, unable to believe his good fortune, "but you're the only one who believes me."

"Oh, Jerry is pretty smart, too," blandly remarked Jerry's sister. "And he's a wonderful salesman!"

IT WAS good to be back on the lot again. Don felt the old thrill as he took charge of the final scenes—the modern sequence in a war hospital where Jerry took the double rôle of himself and his own brother, and where Margaret, the English nurse, at last discovered that the villain and the hero were two different individuals.

In making the final fade-outs, in which Jerry and Margaret held the center of the close-ups, Don experienced some embarrassment. Before his engagement to Judy it had been easy for him to direct a love scene—only a matter of inches and camera angles, with two human automatons going through the traditional motions in the approved cinematic manner. But now his professional detachment was confused with a vivid personal response to such proceedings. And there was a certain dancing light in the eyes of his prospective brother-in-law that made him uneasy.

Was it for his special benefit, Don wondered, that Jerry threw all that ardor into the more tender scenes? Margaret, no doubt reliving for the moment her own shattered romance, was playing up to him very responsively. During the filming of the final fade-out, the lovely expression of her face—an inner glow, enchanted and enchanting—made Don completely forget the practical, unromantic presence of camera man, electrician, and assistants.

He came to himself with a start. How long had Jerry been holding that kiss?

"Break!" he ordered in a voice which he strove to make natural.

The pair instantly dropped their arms and stepped apart. Margaret patted her hair into neatness—did girls always do that?—and Jerry nonchalantly lit a cigarette.

"Any professional suggestions to make on that last shot, Don?" he asked, rolling his eyes wickedly at the young director

"I'm only an amateur," Don replied, grinning, though annoyed at the flush that made even his ears hot. "But your cigarette reminds me of one final trick shot I've figured out for the two brothers."

While Margaret hurried to her dressing room to remove the final grease paint, put on for the picture that was to restore the brilliance of her screen reputation or destroy it utterly, the two men with technical assistants and camera men strolled to the hospital set on another part of the stage.

ONLY the day before, the double exposure reconciliation scene between the brothers had been made. Jerry had assumed both rôles until the final shot, where, having to shake hands with himself, another actor of his size and general appearance had been substituted. During this bit of footage the substitute had kept his face turned from the camera, the mask was removed from the lens, and the shot made straight—not double exposure.

"Now," said Don, "I want to carry the scene a bit further with double exposure. After the handshake you'll sit down on both sides of the picture, face yourself and light your cigarette on one side of the picture from the cigarette you are holding on the other side."

"I'm no magician," remonstrated Jerry. "I can't leave a mark in the air to indicate where I must match the cigarette in the second exposure"

"You won't have to," Don replied. "We're going to work it this way."

Under his directions the two chairs were quickly nailed to the floor and the camera used the day before was screwed back into place. While the shot on the left side was being made, Jerry straddled one chair, his arm resting carelessly on its back. Between his fingers was a lighted cigarette, but just before the last bit of footage was taken on that side the camera was stopped and the film rewound. Then Jerry became the actor on the right side of the set and, while talking with his unseen self on the other side of the picture, slowly drew a cigarette from his case.

When an equal number of feet on both sides had thus been double exposed, the mask on the lens was again reversed, and Jerry, with a newly lighted cigarette, resumed his place on the left chair. This time, however, the cigarette was tucked to the chair back, though he appeared to be holding it between the fingers of the hand that rested there. So close was the chair to the dividing line between the two halves of the exposure that the lighted tip of the cigarette protruded beyond the deadline. After a minute's cranking, timed by the stop watch, the mask was quickly reversed, the film rewound, and Jerry on the right hand chair leaned forward and with an unlighted cigarette between his lips drew a light from the glowing tip of the one tucked to the other chair. In the meantime, of course, that cigarette had been extinguished and relighted in order to preserve its length

"It's like this," commented Don when the shot was completed and he had given the order to strike the set, "completely fool the public. When they see you shake hands with yourself, the wise ones will tell their friends how a substitute was put in at just the right moment—but I'd like to hear a fan try to explain away that cigarette trick!"

AN ANCIENT Pierce Arrow rolled slowly along the Avenue of the Christmas Trees in Pasadena. It was dusk—Christmas Eve—and as the last faint tinge of gray faded from the sky, the mile or more of magnificent fir trees fringing each side of the road suddenly sparkled with myriad colored lights.

Moving more swiftly, the car reached the end of the double row of lights and ascended the gentle hills of Altadena. For sentimental reasons, its five occupants were making this important trip the swan song of the faithful old vehicle. Tomorrow it was destined for the junk dealer. Now it came to a stop before a small bungalow.

In its cheerful living room Don and Judy, young and shining and solemn, took their places within the curve of the bay window. Professor Mahrlenborg stood at Don's left, Margaret at Judy's right, while Jerry and the minister's wife stood on them from a little distance

When the simple wedding ceremony was over and the brief flutter of congratulations had subsided, Jerry looked at Margaret significantly. She smiled. Taking her hand, Jerry turned to the minister

(Continued on page 7...)

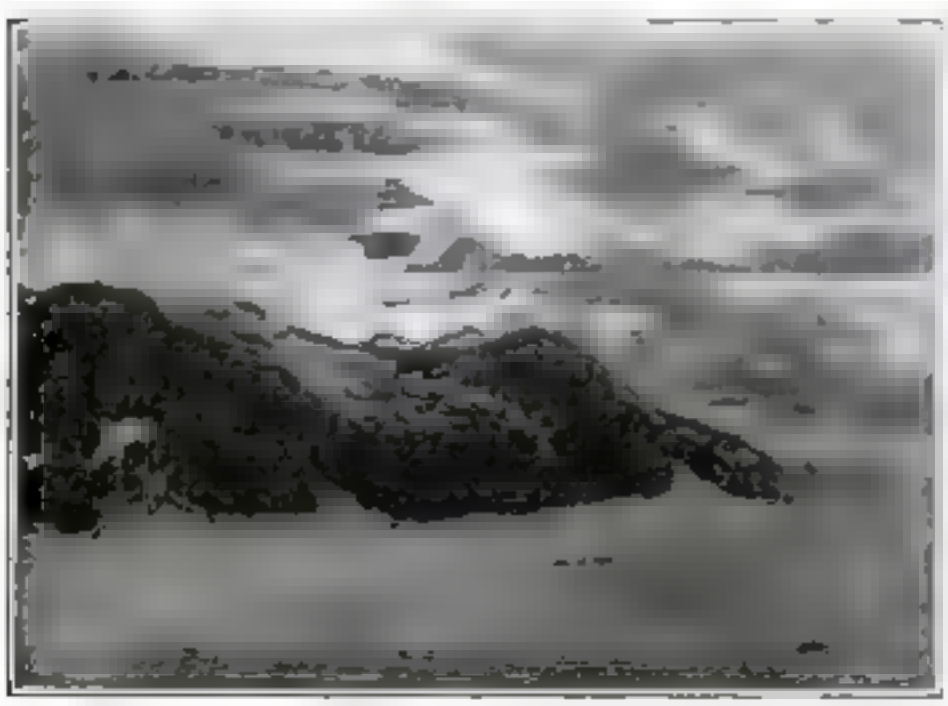
Face Death to Explore Sea of Ice

A treacherous crevasse in the desolate Taku Glacier of southern Alaska, which recently was explored for the first time by Father Bernard R. Hubbard, rotter geologist of the University of Santa Clara, California

A grim and barren wilderness of rocks and ice. Risking life at every step, Father Hubbard and his two companions fought their way up sheer precipices in an effort to conquer the glacier which had defied all men before them

The Jesuit, his guide, Jack Koby, and Henry Pigg, a student, pause for a brief rest before crossing a perilous ice gorge. Starting from Juneau, Alaska, they journeyed northward, going first up the Mendenhall Glacier to the "mouth" of Taku. For sixty seven hours they pushed on through bitter cold, until at last they reached the end of the eighty-seven mile glacier

The explorers with their dogs starting on the tortuous trip up the glacier. Beneath a seemingly level carpet of snow, hidden crevasses lay ready to swallow the men who dared enter the forbidding land of ice. And so they roped themselves together, like Alpine climbers, trusting that if one of the party fell into a yawning hole, the others might pull him back to safety



A photograph of the scene when night was overtaking the explorers on the sea of ice between mountain walls—a scene majestic yet terrible in its hard and cold grandeur. They were the first to set foot on this desolate ice field

Jack Koby, prospector and guide, with the dogs crossing one of the less forbidding stretches of the glacier. Yet even this was dangerous enough to test the courage of the bravest man, since none could guess what pitfalls lay just ahead

Newest Achievements *of the* Laboratories

THE latest steps in research and invention in all scientific fields, important for their bearing on our everyday life, are recorded in these pages.

New Metal Mirror Used in Telescope

AFTER twenty-five years of research and experiment, George H. Lutz, a Chicago engineer whose hobby has made him one of the best known amateur astronomers, has perfected a telescope mirror made of a special new metal alloy that is said to be four times as hard as steel.

Its great advantage is that it resists all the wear that is necessary in use, whereas silvered glass reflectors, no matter how carefully operated, must be renewed from time to time. Mr. Lutz is shown here with the mechanical part of his apparatus equipped with the metal mirror.

Plant Is Living Gas Works

IF YOU read, in our April issue, the fascinating story of Sir Jagadis Bose, Hindu naturalist, and of his discoveries of the humanlike existence of plants, your flower bed and vegetable garden have taken on a new interest this summer. Here is a fascinating world which science is just beginning to comprehend.

Two experts of the University of Michigan, Prof. John E. Weaver and Dr. William E. Bruner, have just revealed that plants are the greatest miners on earth. Radishes, beans, and turnips occupy more space underground than above it. The roots of a four-year-old rhubarb plant were found to occupy a cylinder of soil eight feet in diameter and eight feet deep, while those of a ten-year-old horse-radish plant drilled down more than fourteen feet!

The radish you eat embodies materials drawn from soil two feet underground.

The vegetable world, too, has many strange creatures. One of these, just discovered by Dr. W. A. Hamor, Assistant Director of the Mellon Institute of Industrial Research, is a living gas works. It generates gas which can be lighted with a match. This plant, the dittany, grows in southern Europe and central Asia. Its generating plant consists of glands containing volatile oil. In warm weather the oil evaporates, making the air about the plant inflammable.

Lightning Distance Finder

WHAT the adding machine is to the bookkeeper, and the slide rule to the engineer, a new quick-figuring machine—the trinometer—is to surveyor, gunner and aircraft pilot, thanks to Dr. Joseph E. Rowe, of the College of William and Mary, its inventor. With its aid an airman can tell in an instant how far he is from his destination; a gunner can use the ingenious device as a range-finder.

The trinometer is simply a triangle that measures itself. All surveying and range-finding computations depend upon trigonometry—the science of the measurement of triangles—and the trinometer instantly set to the shape of a triangle being surveyed, records as many of its dimensions as are already known. Then the unknown figures are read off directly from the scale without recourse to laborious calculations.

In the illustration Dr. Rowe is calculating an unknown distance represented by the A-bar. The B-bar and H-bar are set to known distances, and to known angles at A and C, and the answer is read at B.

National Icebox Standards

A FEW months ago the Popular Science Institute of Standards undertook to establish efficiency standards for the guidance of purchasers of household iceboxes and refrigerators. Today that undertaking is joined in a movement for nation-wide refrigeration standards.

Representatives of manufacturers, dealers and purchasers, Government officials, and others interested in the refrigerator problem, including a representative of the Popular Science Institute, met recently in New York City, and voted to establish a set of national standards by which the purchaser can make his selection on the basis of quality and performance. A technical committee, working under the auspices of the American Engineering Standards Committee, will draw up the national specifications.

The need of national standards to guide the purchaser was emphasized by the fact that 12,000,000 refrigerators now are in use in American homes, and each represents a yearly cost of from $20 to $28 for ice or its equivalent. Moreover, in actual tests of three different refrigerators of about the same size, it was found that one

Dr. Lee R. Travis and Theodore Hunter, of the University of Iowa, have made good their statement, which appeared in Popular Science Monthly for June, that the sounds of human nerves in action which they had heard could be amplified and broadcast by radio. They put the nerve noises of Captain Cubel of the University track team on the air. The athlete is seen here with the nerve sound recording apparatus, connected with radio broadcasting equipment, attached to his leg, and Hunter is stimulating his nerves to action

Woman Doctor May Win Nobel Prize for Cancer Research — Plants Manufacture Gas — City of Apes Planned Man Swims Immune Among Hundreds of Huge Sharks

melted twenty-two pounds of ice a day another twenty-eight pounds, and a third thirty-four. In other words, the third refrigerator required more than fifty percent more ice than the first. Yet the buyer, unaware of this, might pay more for the poor refrigerator than for the good one. For the most part the purchaser has been compelled, in making a selection, to depend on appearance, which often is misleading.

The Popular Science Institute has taken a leading part in making laboratory tests of well known types of refrigerators and so judging their value by actual performance. The project of the American Engineering Standards Committee, in which the Popular Science Institute is cooperating, assures every purchaser getting his money's worth.

Prof A P Wiechelt of the University of Wisconsin, is "fingerprinting" his six hundredth mineral. With a Coolidge X-ray tube in the cylinder he makes photographs showing detailed structure of metals. Geologists in all parts of the world can compare new found specimens with these pictures, thus simplifying identification

Woman Leads Cancer Study

For [illegible] work and achievement in cancer research, Dr Maude Slye of the University of Chicago, was recently recommended by the American College of Physicians for a Nobel Prize Award. Sober of countenance her short-bobbed hair shot through with gray the woman scientist is called the foremost cancer authority of the West. Her experiments with mice have led her to state the belief that cancer is hereditary and that it would disappear in two generations of scientific mating.

What Kills Ultra-Violet Rays?

TESTS have shown that the ultra-violet rays of the sun, valued for their germicidal and stimulative qualities, exist in less quantity at street level than at the tops of tall buildings, and scientists have speculated on the agency that robs the lower air of the health-giving light. Experiments recently were conducted by the Health Department of Baltimore regarding the belief held by Dr James H Shrader head of the Bureau of Food and Chemistry, that the ozone produced by the electricity in street railway wires might absorb or kill the ultra-violet light. Dr Shrader has designed an apparatus for collecting and testing ozone at ground level, in various sections of the city

Does ozone, the peculiar smelling gas produced by electrical discharges, absorb or destroy some of the sun's ultra-violet light? To find out, Dr. James H Shrader, of the Baltimore Bureau of Food and Chemistry is seen collecting and examining the electric-made substance with an apparatus designed especially for the purpose

Sharks Refuse to Eat Man

SHARKS—except one species—do not bite men.

That is the verdict brought back from the Bahama Islands by Van Campen Heilner, ichthyologist of Spring Lake N J As forecast in "Risking Death for Science," in our May issue, Heilner plunged into shark-infested waters, to settle the dispute whether sharks are naturally man-eaters

"Sharks and barracudas did not bother me in the slightest Heilner reported. "The sharks fled at the slightest noise, and the barracudas evinced only curiosity. One shark, harpooned, attacked our boat, but he was acting in self-defense."

A City of Apes

A BATTALION of chimpanzees and other apes is being recruited to help their human cousins stamp out insanity and crime.

The Medical Center in New York City announces that a community of apes soon will be established. The animals will be made subjects of tests of effects of narcotics, alcohol, and infectious diseases on successive generations.

Their psychological reactions to poisons, and the effects on their offspring, may shed valuable light on why some children come into the world with subnormal minds.

We All Walk in Circles

IF WE couldn't see where we were going, we'd run in circles. Persons lost in the woods often turn completely around

Experimenting with blindfolded persons, Prof A A Schaeffer of the University of Kansas recently discovered that our natural tendency is to walk in narrowing spirals, like a clock spring. Some people turn to the right, others to the left. Professor Schaeffer found that fish follow the same course.

Just why we have this tendency the psychologists are seeking to explain

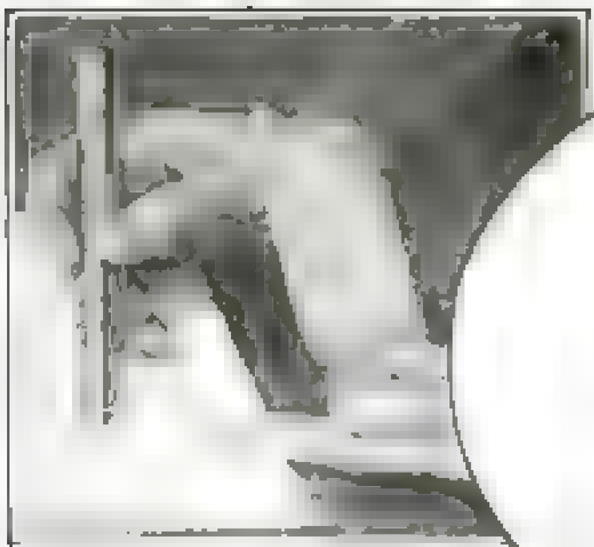
4,524 Deaths Due to Falls

A VETERAN of the fiercest fighting in France tripped on a shoe string, fell headlong, and broke his neck. A steeplejack who had just performed breath-taking feats on a skyscraper stumbled on a curbstone and was crippled for life.

Such incidents are not infrequent. People, as a rule, consider their own chances of such accidents remote. The latest statistics compiled by a leading accident insurance company, however, show that the average man's chances of being injured by a fall are almost as great as of being maimed by an automobile.

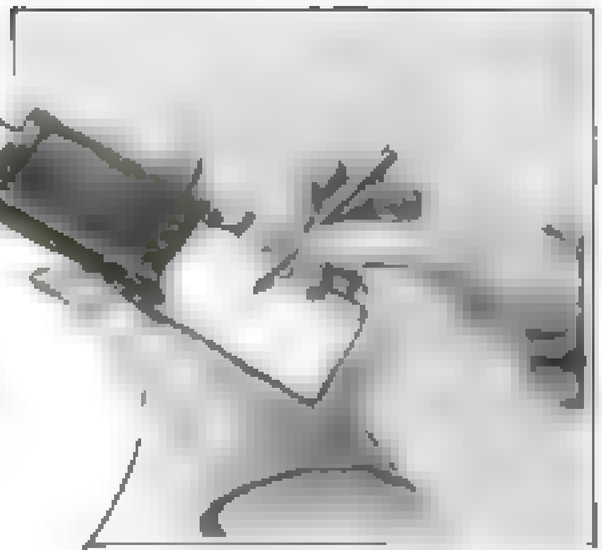
Of 22,000 accidents outside of industry, 6,647 were caused by automobiles, and 4,524 by falls. Next came injuries in sports, 4,452. Seventy three were hurt getting in or out of bed, and sixty-four suffered from falls in bathtubs.

Surprising New Ideas of Inventors



Mucilage Fountain Pen

Designed for pocket or desk, this de[illegible] has [illegible] mucilage [illegible] everywhere which [illegible] refilled [illegible] removing the [illegible] the cap. Press [illegible] the object to be gummed [illegible] a drop of the mucilage. It closes automatically as pressure is released

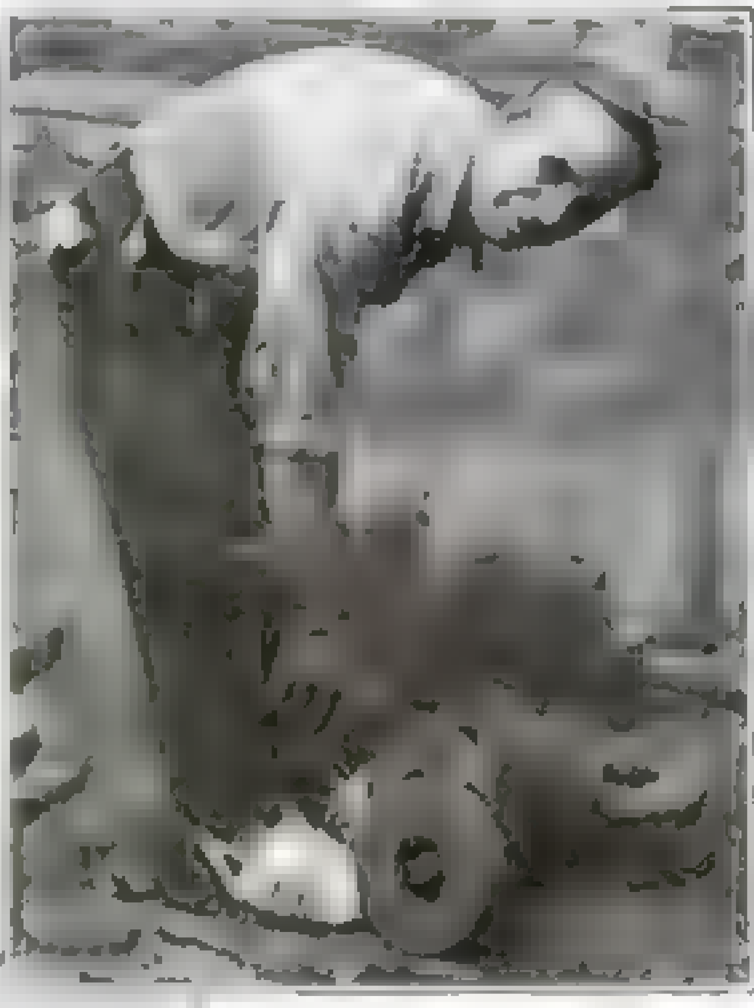


Flashlight Writing Pad

How often you have fumbled for pen[illegible] and paper and held a match to make notes in the dark. An English [illegible] the difficulty with this [illegible] pad and flash bulb with pencil attached, which is light and folds compactly to fit in the pocket

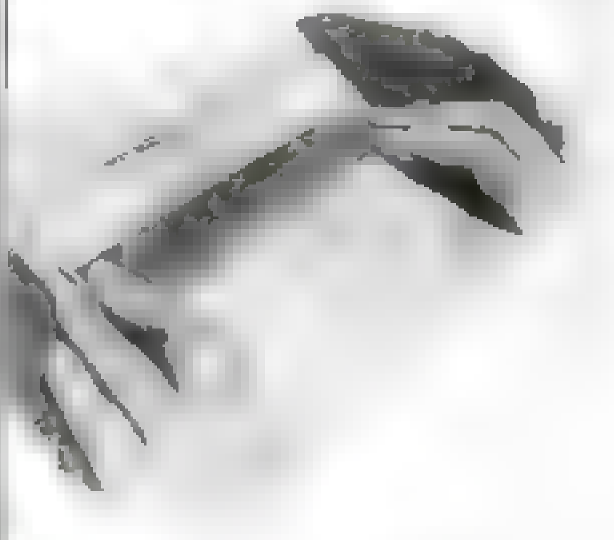
New Razor Blade Holder

The [illegible] handle may be set [illegible] angle [illegible] scraping [illegible] other purposes [illegible] shaving



Toe Guards Save Injuries

Light but strong shields strapped over the shoes protect workmen handling heavy [illegible] in an [illegible] mill. Made [illegible] of a special steel, they weigh [illegible] 10 [illegible] and of aluminum only 6. They are tested to resist a pressure of 300 foot pounds

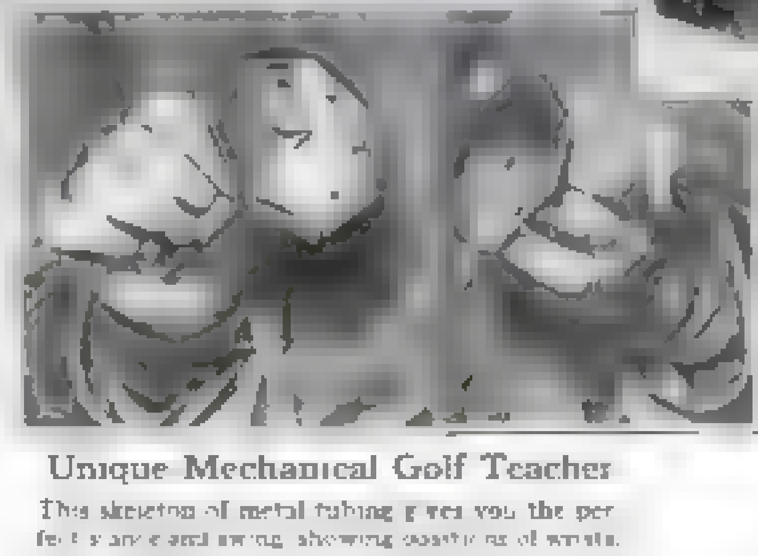


Line Guide Aids Typists

This [illegible] glass with the lower half [illegible] green [illegible] The green band [illegible] at the same time [illegible] transparent enough to permit the sight of the [illegible] below

Driver's Heel Guard

Now that summer is here these [illegible] shields hook into the [illegible] shoes, [illegible] them from wear and [illegible] when she goes driving



Unique Mechanical Golf Teacher

This skeleton of metal tubing gives you the per[illegible] stance and swing, showing positions of wrists, arms, shoulders, hips, legs, and head at all stages of the shot. Photograph shows a follow-through

Seven Sided Razor

The novel [illegible] in the blade [illegible] a new [illegible] edge each day, the sections being labeled Monday, Tuesday [illegible] avoid [illegible] Once a week it is sharpened

Liquid Stocking Mender

A drop of [illegible] saves nine stitches and [illegible] stocking [illegible]. [illegible] the work [illegible]. The tiny flask will fit in the hand bag.

Windshield Screen Keeps Out Dirt

Insects and dust [illegible] are excluded, according to the inventor, by this [illegible] which is made to fit the [illegible] known makes of [illegible] and can be easily and quickly [illegible] to add to motoring pleasure

New Shaving Idea

[illegible] the shaving mug, this [illegible] holds [illegible] soap [illegible] of the brush when the valve is pressed. Then [illegible] applied [illegible] worked up on the [illegible]

Safety Fuse Pulling Device

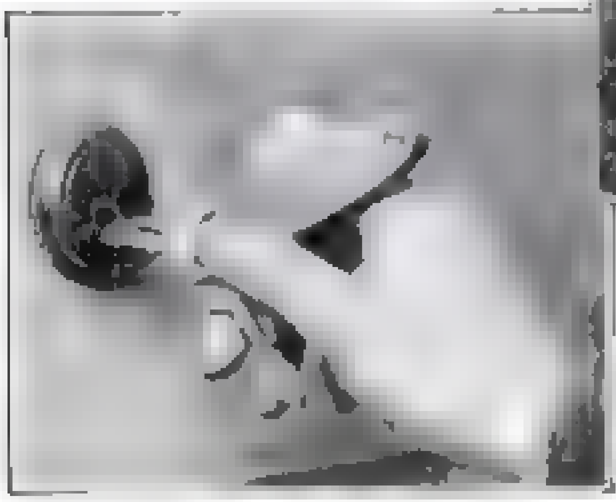
A new [illegible] tool with [illegible] on one end and a screw [illegible] on the [illegible] easily and safely handles [illegible]

Device Shows Notes to Speaker

Lecturers who use notes or read their addresses [illegible] this [illegible] machine. [illegible] as the speaker presses [illegible]. A [illegible] magnifies the [illegible] so that they are easily read while a shaded light illuminates them

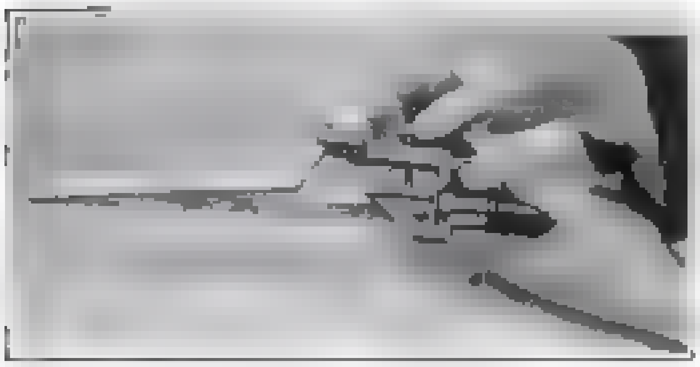
A Bathing Machine

[illegible] water



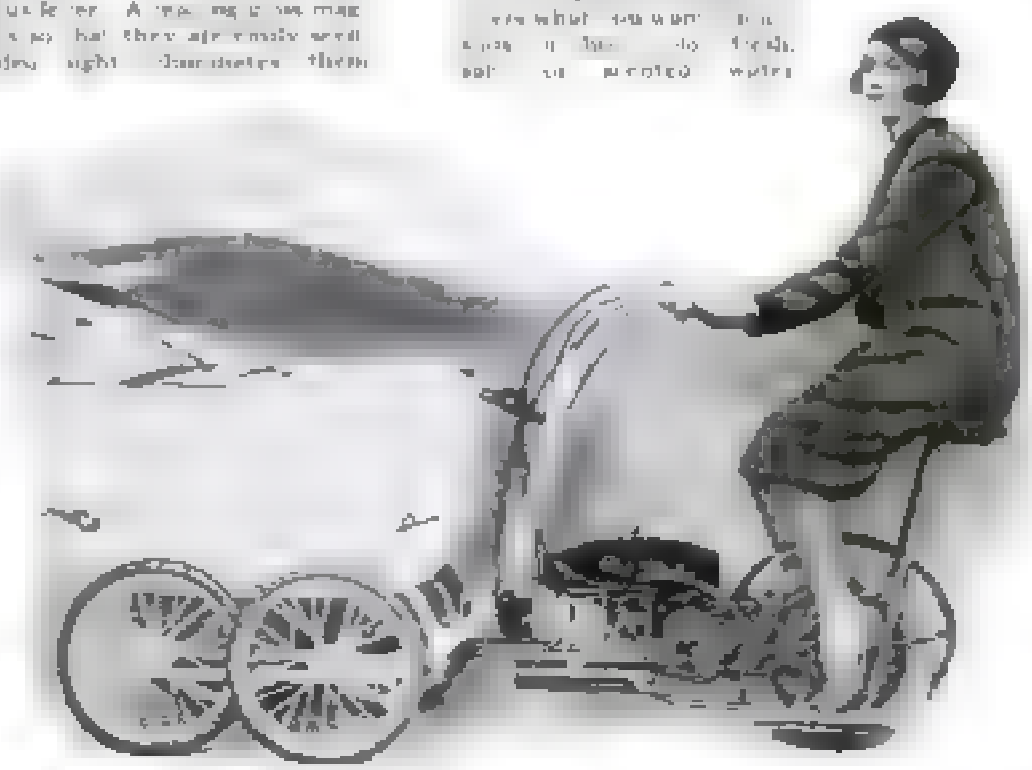
Pocketknife Handle Carries Keys

Keys are carried [illegible] and without [illegible] in this device. They are inserted like knife blades and when not in use close into the handle. The holder is said to take up less room in the pocket or purse than other familiar types of key holders



New Frame Multiplies Hack Saw Uses

By adjusting this frame, interchangeable in four ways, the blade is lengthened or shortened as conditions require, permitting the tool to be used in tight places



Motorized Baby Buggy Does Mile in 40 Minutes

This English conveyance—a real little automobile—also provides a seat for nurse or mother. Brake levers and spark and gas control are fixed on the handlebar

Sailors of the U. S. S. *Holland* attaching lines to the sunken submarine *S 17* in preparation for her raising by the *S 19*, pictured in upper illustration

Submarine "Sunk" in Test Is Raised in Half Hour

THE U. S. Submarine S-17 was sunk [illegible] another day [illegible] Navy [illegible] be prepared in case of another such disaster as that of the S-4. The S-[illegible] boat tanks were filled with water. Divers attached an air hose from the S-19 to the "lost" ship's tanks from which the S-19 then blew the water, causing the "wreck" to rise to the surface of the harbor

Look Out for Poison Ivy Now!

BEWARE the poison ivy, with its three trifoliate leaves in a cluster! At this time of year, the U. S. Health Service warns, the curious plant poison that causes skin irritation, violent itching and burning sensations is particularly virulent

Unless you are one of the lucky persons who are partly immune—and experts believe there is no such thing as absolute immunity—you may acquire the poison either from brushing directly against the leaves or from standing in the smoke of burning ivy. The smoke contains a finely divided but heavy dose of poison and causes some of the worst cases of ivy poisoning. Whether you can be poisoned by the growing plants except by actual contact is doubtful

Some persons are naturally more susceptible than others, but even the most hardened have been at least mildly poisoned, in experiments after severe and prolonged exposure. The safe thing is to avoid the weed altogether; and that is not difficult, for it is easily detected.

Its shiny green, notched leaves form a three-leaved cluster that at once distinguishes it from the Virginia creeper or any other plants with which it might be confused. And the toxic relatives of the poison ivy—poison oak and poison sumac have leaves of different shape, though also in the pattern of three.

Only arid lands and mountain elevations above 6,000 feet are free from the countrywide invasion of the poison ivy and its ill-famed relatives. Its foliage festoons ravines and hillsides alike, turning in autumn to beautiful scarlet and orange hues to decoy leaf collectors.

Persistent, repeated mowing, or deliberate grubbing out by the roots, will destroy poison ivy near the home. Spraying with kerosene is recommended by the Forest Service of the Department of Agriculture when other plants will not be damaged. One thorough spraying is often sufficient. And a solution made by dissolving one to two pounds of arsenite of soda in ten gallons of water will kill poison ivy on stone fences, buildings, and walls, the Massachusetts Experiment Station has found. This concoction also destroys shrubbery but does not harm large trees.

There is no mystery about the poison itself. An oil secreted in the plant's leaves, roots, and berries, it has been isolated, squinted at in test tubes under lenses, and given the formidable name of toxicodendrol. It behaves much like such other irritant poisons as bichloride of mercury, arsenic, and certain aniline compounds found in dyes.

After exposure, a thorough washing with soap, water, and alcohol may avert a case of poisoning. The treatments for an actual case are simple and easy. One of the best is bathing with salt water, sea water if available. Another is a wash daily with a teaspoonful of boric acid dissolved in a quart of hot water.

Scientist's "Talking Book" Soon Ready to Read to You

THAT he is working on an electric device that reads a book aloud has just been revealed by Dr. W. R. Whitney, director of research of the General Electric Laboratories. In reality this device, he explains, will be a long-running phonograph that uses, instead of wax records, long strips of photographic film such as are employed in "talking movies." The words it reads will have been recorded previously in a studio. Since there are no pictures on the film, its whole surface can be used to record sound photographically, and an entire novel can be condensed into a film reel that takes two hours to run. You would procure such a film from an electric or radio store. It should be bought for about six dollars, or else rented, Dr. Whitney predicts, when the machine is eventually perfected.

Dr. Whitney is not trying to produce a device that can read aloud mechanically from an ordinary book. Another expert, Dr. E. E. Fournier d'Albe, of London, attempted that some years ago. His "optophone," with its electrical eye, could translate printed characters into distinctive sounds; but they were arbitrary and bore no resemblance to the English language, in which the same letter combinations often have different inflections.

Human Traffic Signal Lights

TRAFFIC policemen in Bath, England are equipped with the novel electrical flash-signal shown below to protect them from being run down by careless motorists. A small battery which is carried on the officer's belt supplies the necessary electric current to operate the "human lighthouse," and [illegible]

A Bath, England traffic policeman with the new warning light for motorists on his head and battery that furnishes current for it fastened on his belt

Earthquakes Made to Order To Help in Railroad Survey

EXPLOSIVE charges, set off underground, are helping Russian engineers to survey the route of the proposed Turkestan-Siberia railroad. The man-made earthquakes, recorded on portable seismographs, reveal the geologic structure of the underlying rock. The unusual method is the same that has been successfully used in this country to locate underground "salt domes" which indicate the likely presence of subterranean oil.

Rescuing a Dying Language

SAVING a dying language that in a few years would be extinct was the task that Dr. F. G. Speck, anthropologist of the University of Pennsylvania, recently set himself. He has just returned from a hurried trip to the Catawba Indian reservation in South Carolina, where he learned what he could of the ancient Catawba tongue from the only remaining persons who speak it—two old Catawba women, Mrs. Samson Owl and Sally Brown. His records of the angular, one-syllabled tongue will be preserved by the Committee of Research in American Indian Languages. The once-powerful Catawba nation, descended from the Ohio mound builders, has dwindled to thirty warriors and 170 persons altogether.

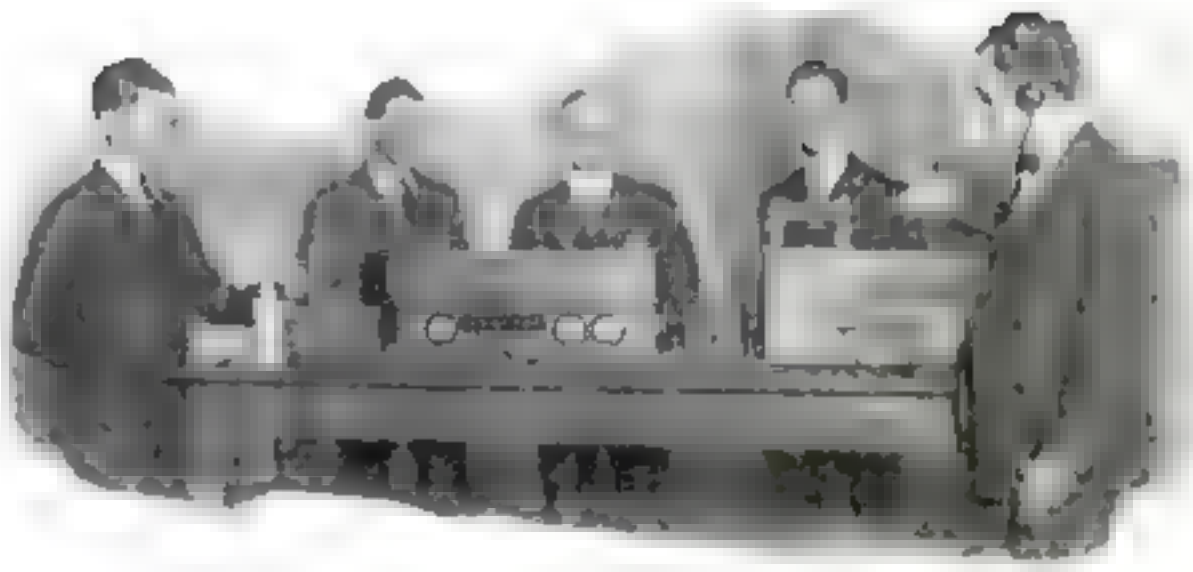
Snakes and Ultra-Violet Rays

THAT there may be truth in the belief that poisonous desert snakes are the deadliest is suggested by the recent report of two investigators to the French Academy of Sciences. After exposure to ultra-violet rays of light snake venom, they found became increasingly fatal. Animals injected with the poison after it had been exposed to the rays died more rapidly than others on which ordinary snake poison was used. These rays are in sunlight and are most intense in deserts.

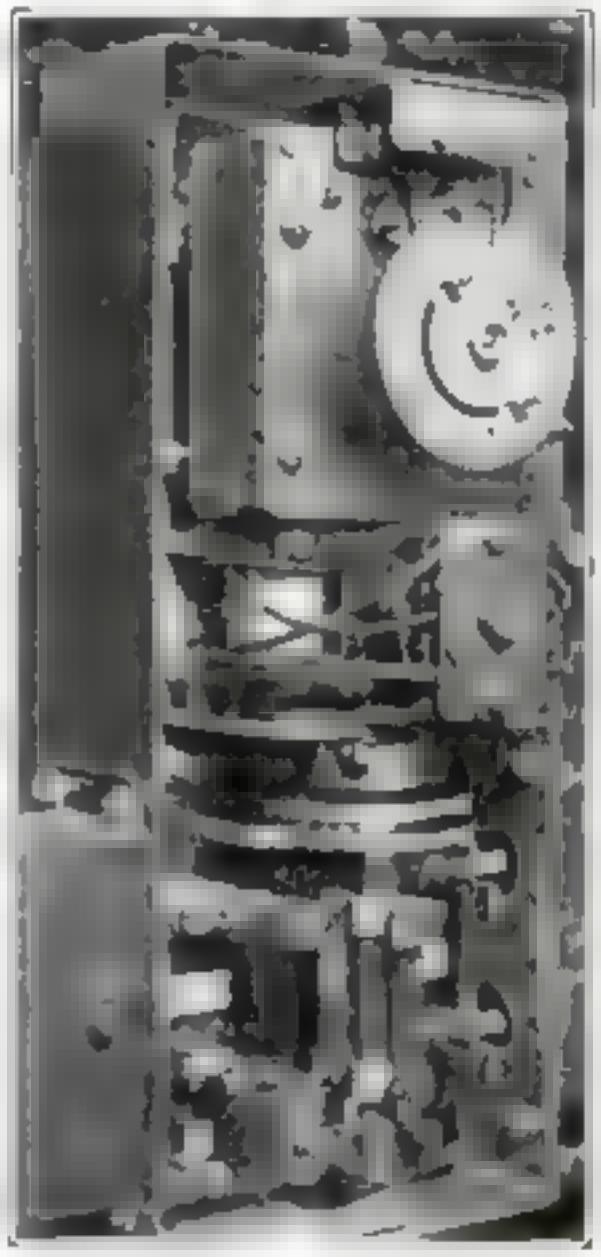
Push Buttons Tune Radio

TUNING-IN a desired broadcasting station is merely a matter of pressing a button or throwing a lever, in the new automatically controlled radio receiver perfected by Harry N. Marvin, inventor and moving picture pioneer of Rye, N. Y., shown with it below. The necessity of turning dials is eliminated by the device.

Harry N. Marvin operating the radio receiving device it took him 5 years to perfect which tunes by pressing of buttons or throwing of levers



Listening to Roar of Somersaulting Atoms



ROARING noises that rivaled Niagara nearly deafened scientists who recently listened to billions of atoms in a bar of iron turning somersaults at a demonstration given by Dr. H. Clyde Snook in New York. Although so small that over one hundred million of them would form a line less than an inch long, these tiny particles of matter are not too small to be heard when their sound is amplified by an apparatus developed by the Bell Telephone Laboratories and used by Dr. Snook. The noises were magnified to ten billion times their original strength.

Clock Controls Street Lights

OPERATING according to the hours and minutes of daily sunlight, this remarkable newly invented astronomical clock turns on the street lights when the sun sets in the evening and switches them off in the early morning when the sun comes up over the horizon.

More than a hundred miles of brightly illuminated streets in Oak Park, Ill., are now without a single moment of darkness, due to the installation of this automatic "sun switch" at a cost of $1,036,000.

Fireless Mine Blasting Gas

HIGHLY compressed carbon dioxide, the same gas that is used under moderate pressures in many household electric refrigerators, has been successfully tried as an explosive at the Jack Branch coal mine in Maybeury, W. Va., according to Robert M. Lambie, chief of the West Virginia mining department. Not only does it banish fire and explosion hazards, but it has proved a worthy commercial competitor of standard blasting powders.

Two-foot steel shells containing the liquefied gas are thrust into drill holes in the coal bed. Electric heating fuses boost the liquid's pressure from 2,000 to 20,000 pounds to the square inch, at which point it explodes, breaking out the coal.

Cruiser Sets Speed Record

STEAMING at a 36.3-knot clip, equivalent to forty land miles an hour, the French cruiser *Tourville* recently made what is claimed to be a new speed record among the navies of the world. A short time before, a French cruiser, also of the 10,000-ton class, the *Duguesne*, made 35.4 knots. The *Tourville's* engines develop 132,000 horsepower.

Glass Blackboards Proposed

BLACKBOARDS of glass, translucent and illuminated from behind, are foreseen as school equipment in a recent report of the American Physical Society. Writing on such boards, tests showed, could clearly be seen from any angle. Also, the board can serve as a screen for projection of lantern slides, and, with a diagram thrown on the screen, chalk lines can be drawn to supplement it.

New *Gains in* Conquest *of* Air

The new German [illegible] Dornier Super-metal flying boat on her successful trial flight over Lake Constance, Switzerland. Her four Siemens engines develop a total horsepower of [illegible]. Its passengers [illegible]. Its maximum speed is 135 miles an hour

Statistics Show Flying Safer

WHILE more airplanes are flying farther with heavier loads than ever before the number of flying accidents is steadily decreasing. That is the verdict of Dr. F. L. Hoffman consulting statistician of the Prudential Life Insurance Company, after studying flying hazards.

Two years ago 160 persons, including pilots, mechanics and passengers, were killed. In 1927 there were among 1,680 licensed pilots, only eleven fatalities.

In Alaska, where flying conditions are unusually severe, airplanes have flown 300,000 miles without injury or loss.

In England during three years ending with 1927 planes of the Imperial Airways flew nearly 2,500,000 miles and carried about 52,000 passengers without a fatal accident. Dr. Hoffman contrasts this record with that of the British railways in 1842, when railroading was years older than aviation is now. In that year eight railway lines carried 10,800 passengers for a distance of 3,300,000 miles, and twenty-two passengers were killed.

All-Metal Steam Dirigible

ITS envelope already more than half completed, an all-metal experimental dirigible that Thomas B. Slate is building at Glendale, Calif., is expected to be finished and ready for test some time this July. It is a 150-foot craft of extraordinary rigidity, despite its light weight. Installation of machinery, accessories, and a passenger cabin are to be made immediately. Instead of the usual spinning propellers, a blower mounted at the nose and run by a steam turbine is to propel the ship with a jet of air.

Chasing Bandits with Plane

CHASING bank robbers by airplane was recently tried out by an Illinois law enforcement association. It staged a mimic bank robbery in some Lake County city, the name of which was kept secret. The "bandits" made their escape in a high-powered automobile, of which a description was telephoned to the Ford airport near Hammond, Ill.

An airplane waiting there took the air in quest of the "robbers." It picked up the motor car before the "gang" reached the safety of Chicago's traffic maze, and "bombed" it from the air. Since the novel experiment proved successful, outlaws may have a new weapon, the airplane, to fear.

Plane Surveys Electric Line

WITH three trips of a speedy camera seaplane over rough, undrained lake districts between Toronto and the Ottawa River, a 200-mile route for a high-tension electric line recently was surveyed at a saving of weeks of ordinary surveying and great expense. With photographs taken from the airplane, a survey party was able quickly to locate the chosen route and immediately acquire the necessary property and tower sites.

Air mapping, according to the Army Air Corps, which has developed it to a fine art, is far more accurate than that by any other means. A recent survey of Alaska could have been accomplished in no other way, unless years of time and great sums of money had been spent. Now Army aviators are engaged in mapping wide sections of the United States, including the Florida Everglades.

E. N. Armstrong of Hoboken, N. J., shows a model of the huge mushroom type anchors, forming a vacuum and clinging to the ocean bed, by which he proposes to anchor great floating airports at various points in the oceans

One of the most powerful night flyer's beacons, which casts a 10,000,000-candlepower beam 150 miles over land and sea from Mt. Diablo, near San Francisco Bay. It has two 1,500-watt incandescent lamps, one of which lights automatically if the other one fails. The light is projected from the 75-foot tower by a 36-inch reflector and a gigantic lens

Wing Slots Make Crash Safe

BEFORE a crowd of shuddering spectators at the Stag Lane airdrome in London, the other day, Capt. G. de Havilland, noted British airplane designer and pilot, deliberately pointed his Moth plane at the ground, crashed, and stepped from the shattered fuselage unhurt. It was a spectacular demonstration of the way that the new Handley-Page wing slots, described in the February POPULAR SCIENCE MONTHLY, make an ordinary plane fool-proof. The U. S. Government acquired the rights to use the slots in military aircraft.

Without such slots, a maneuver like that of Capt. de Havilland would have been suicidal, but they held the plane's descent to a maximum fall of nine miles an hour vertically—enough to crack the fuselage but not to injure the pilot. By trapping the air stream passing over a plane's wings, the slots give a pilot extraordinary control over his machine at times when he would otherwise be helpless to prevent disaster. In particular, the U. S. Navy expects the slots to make possible slow-speed take-offs and landings of planes on its new aircraft carriers. The wing slots can be easily fitted to machines already in service.

All-Metal Steam Dirigible Nears Completion and Greatest All-Metal Plane Flies Air Safer Now Than Trains in 1842

Hubert O'Neil, University of California senior (left) who learned to fly in six hours with Martin Jensen, noted aviator, his instructor, before first solo flight. He landed unhurt but damaged the plane beginning of the trials, did the emergency pilot need to take control of the plane.

Gold Rush Made in Planes

FOUR small and four large planes have just been ordered by a recently organized Canadian mining company to be used in exploring and developing mineral areas over the whole of Canada, according to the Trade Commissioner at Toronto. Prospectors will fly into new gold fields, stake out claims, and return to register them. The large ones are to transport engineers and mining machinery.

Airplanes are fast turning the old fashioned "gold rush" from a tedious expedition of months into a jaunt of a few hours. When Floyd Bennett and Bernt Balchen tested Commander Byrd's South Pole plane in Canada, they took advantage of the opportunity to beat the latest gold rush from Le Pas, Manitoba, to the Reindeer Lake country, and staked out thirty-one valuable claims in a region they had all to themselves. Fourteen other prospectors then obtained planes and followed their example; while the rest remained at Le Pas, awaiting spring thaws to make the land trip passable.

Echoes Tell Plane's Height

A SERIES of explosions like a machine gun's rat-a-tat-tat, within a plane's undercarriage, tells an airman his exact height, even when the ground is obscured by the thickest of fog, in a new device to be installed on French aircraft. Electric sound detectors pick up the echo from the ground and gage the craft's altitude. The device which has an indicating dial in the cockpit is effective as close as one foot from the ground, it is said.

Meanwhile twelve prominent French pilots, interested in safe flying through fog, have performed the experiment of "flying blind" or relying upon their standard instruments alone. Each sat completely shut in and unable to see outside, in a plane equipped with dual controls. Another pilot in each forward cockpit was ready to grasp the "stick" if the "blind" pilot faltered. Thus they repeatedly flew to designated points. On only two or three occasions, at the

Collegians' Altitude Race

A NEW kind of intercollegiate contest is scheduled this month at Mitchel Field, N. Y., where college airplane pilots will match their planes against one another in a novel race. Altitude and speed combined make the goal; the team whose members, flying singly, soar a mile high in the shortest time, will be the winner.

Pilots may fly their own or borrowed planes. There are about twenty college aero clubs in this country, most of whose members fly small planes of low horsepower. In the race, to give all a fair chance, planes will be hauled in proportion to their wing surface. Five thousand dollars in prizes are offered.

Lindbergh Gets New Plane

COL. LINDBERGH's interest constantly flitted here since his pioneer flight to Paris in the spring of last year, first into retirement on the wings of his new plane, a photograph of which appeared in the June POPULAR SCIENCE MONTHLY. Its motor, a beautiful nickel plated mechanism, gift of the Wright Aeronautical Corporation, is said to be the finest the Wright factories have ever made. The mechanical bird itself is slightly larger than the famous Ryan monoplane *Spirit of St. Louis*, it is by the same makers. Great spotlights, suggested by Lindbergh himself, are "eyes" upon the wings that make night landing easy.

The Colonel recently denied that he planned a round-the-world flight or a trans-Pacific hop, as persistent rumors stated. He said he planned henceforth a quiet life as far as possible from the well meaning throngs that have overwhelmed him wherever he has appeared.

Smithsonian Credits Wrights

FORMAL credit from the Smithsonian Institution for having made the first man-carrying flight in air history marks the latest step in the controversy which recently caused Orville Wright to remove his original plane from that institution and ship it to the British Museum.

This dispute hangs on the flying ability of the "aerodrome" designed and built by the late Samuel P. Langley, then secretary of the Smithsonian Institution. Smithsonian officials had placed on his machine instead of on the Wrights', exhibited alongside, a label designating it the first craft "capable of sustained free flight under its own power carrying a man."

It was not "capable," Wright declares. On its first try-out it dived into the Potomac River. Years later, after Langley had died broken hearted, Glenn Curtiss rebuilt and flew it successfully, after making changes that Wright says proved its original design was incorrect. Meanwhile the Wrights made their famous pioneer flight. Prominent Smithsonian officials hope the Smithsonian Institution's latest action will induce Orville Wright to bring his plane back.

Aviators Shot from Guns

PILOTS of falling planes are literally to be "shot" from their seats by a new German compressed air gun, so that they can open their parachutes in time to land clear of the planes. The novel device, which is to be exhibited at Cologne, is intended to avert the danger that an airman, jumping to save himself, may foul his parachute on the plane. A pull of a hand trigger, and he is shot free. Pneumatic cannons used on German vaudeville to hurl performers from eight to a hundred feet in the air were the inspiration of the airplane device, according to the inventor.

First photographs of the Beardmore *Inflexible*, world's largest all metal monoplane recently built and successfully tested in England. Squadron Leader J. Noakes flew the giant fifteen minutes to an altitude of 2,000 feet. Note the size of the craft in comparison with the men in the pictures. The plane weighs 15 tons and its huge tired landing wheels are 7½ feet high. The wing spread is 150 feet. The huge plane's motive power consists of three Rolls Royce Condor engines, each capable of developing 650 horsepower

Machines Spread "Stop Thief" Alarms

THE speeding of general alarms for the apprehension of lawbreakers in New York City's five boroughs is speeded up by the recent installation of telegraph typewriters in the scores of precinct police stations scattered through the metropolis. The mechanical telegraphers relieve a large number of operators for use in other police capacities. Mayor James J. Walker is seen flashing the first message on the first transmitter in police headquarters. The machines also carry routine information and orders.

A Motor Car Built to Skid

DESIGNED to skid as often as possible, a novel automobile built by the National Physical Laboratory, in England, will eventually make motoring safer. By driving over different types of road in all sorts of weather and changing the types of tires, the investigators hope to determine the best tire equipment and pavement to make motoring safer.

Pipe Line Saves Potato Crop

WESTERN irrigation methods were successfully applied not long ago by Lewis A. Toan, New York "seed potato king." When excessive drought withered his potato vines, Toan recalled a scheme he had seen used in Montana. He piped water from the village main, a quarter of a mile away, and saved his entire crop by the method seen at the right in operation.

Lightning Immunity Zones

ABOUT every tall building equipped with lightning rods there is an invisible, but ever-present, cone-shaped zone of safety, according to F. W. Peek, Jr., engineer of the General Electric Company. Tests made during storms have shown, for instance, that the Woolworth Building in New York City is not only itself immune to lightning bolts, but creates all around it a conical protected area whose base is 1,100 feet in diameter. Had the Pulitzer Building—slightly outside this range—been 900 feet closer to the Woolworth Building, it would not have been struck by lightning last summer, Peek declares. Engineers are applying their recently discovered knowledge of lightning-proofing, acquired in laboratory experiments at Pittsfield, Mass., to the protection of oil tanks in the southern part of California.

Gasoline Tax in 46 States

MOTORISTS who tour and those who merely drive near home are contributing to the cost of the highways in forty-six states and the District of Columbia through taxes levied on the gasoline they use. This revenue means of supporting the nation's network of roadways started in 1919, when three states levied a one-cent tax on each gallon of gas sold. Today only two states, New York and Massachusetts, are not asking motorists to help pay for the roads by a gasoline surcharge, while five states collect five cents for each gallon.

With an irrigation method unique in the East, Lewis A. Toan, New York seed potato grower piped water ¼ mile to save his crop from drought

Tiny Meteorite Hits Baby, Second Instance on Record

THE second recorded instance of a meteorite hitting a human being has just been reported from Japan, where a tiny pebble of celestial origin seared the neck of a three-year-old baby girl at play in Sukata, near Tokio. Despite the tremendous number of meteorites that are known to bombard the earth each day, so rarely do they happen to fall within range of civilization that there is but one fatal accident on record—a falling stone from the heavens that killed a man in India, in 1827.

The Japanese baby's mother found the tiny stone, still warm, in the folds of the child's dress. Examined at Kyoto University, it proved a typical meteorite with a black crust formed by melting in its earthward flight through the air. It was only a quarter of an inch long and weighed but a few grains—probably the smallest meteorite ever recovered.

World's Most Silent Room

THE world's most soundproof room has just been completed at the University of Utrecht, in Holland. Its silence is nearer absolute than that of unexplored mountain peaks or Arctic wastes. Sensitive instruments it contains might tremble faintly should a jazz band burst forth outside, but the human occupant could hear no sound.

The unique room was designed by Prof. H. Zwaardemaker to test the behavior of human ears in experiments that would be ruined by the slightest accidental noise. It is built like a thermos bottle, for it is a room within a room, from the space between its double walls, air has been pumped out to leave a vacuum. The walls themselves are made of alternate layers of lead, wood, and felt, while the entire chamber rests upon pillars built of concrete, wood, and horsehair.

Ultra-Violet Light Varies

JUST as there are seven widely distinct visible colors, ranging from violet to red, there are absolutely distinct "colors" of the invisible ultra-violet light so widely advocated for health treatment, two New York City physicians, Dr. H. Goodman and Dr. W. T. Anderson, recently announced. Not all these "tints" have curative powers, these doctors say, and to end the confusion regarding them and the benefits of "sunlight lamps" that purport to produce them, some standard method of rating the rays is urged.

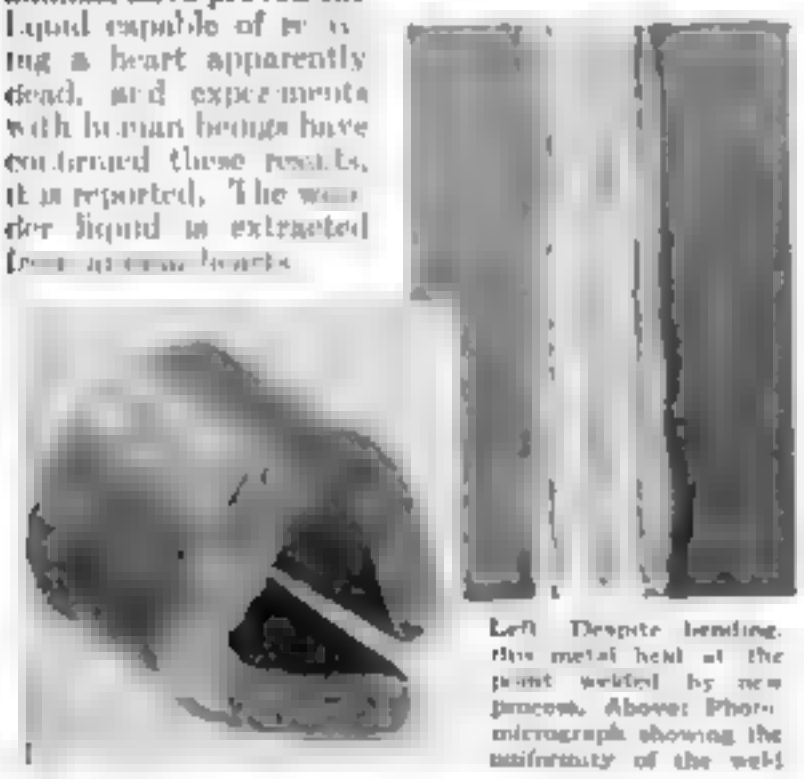
"Extravital" "vital," and "intravital" are names proposed for the most important "colors." The first produced only by certain lamps, have some bodily effect; the second are real health rays, found in sunlight as well as lamps; and the third, nearest in character to visible light, have no known value whatever.

Seven Babies Born at Once Make Twins Seem Ordinary

TWINS are commonplace compared with some remarkable cases of multiple births noted in medical literature. There is one recorded instance of seven living children born together. All but one died. Five cases are known of six children born at once. Even quadruplets seldom all survive as have four girls of the Keyes family, born at Hollis, Okla., fourteen years ago. One in a hundred is about the average of twin births to single ones; triplets, one in 6,000 times. Five births at a time happen only once in ten million cases.

Heart Revived After 2 Days

JUST a few drops of a clear yellow liquid started an animal's heart beating again two days after it was removed from the body, according to reports from Australia. This miracle-performing chemical will soon be available to the world, declares Prof Ludwig Haberlandt who calls his preparation the most powerful heart stimulant known. Tests with animals have proved the liquid capable of restoring a heart apparently dead, and experiments with human beings have confirmed these results, it is reported. The wonder liquid is extracted from animal hearts.



Left: Despite bending, this metal held at the point welded by new process. Above: Photomicrograph showing the uniformity of the weld

A Word-Puzzle Tablet in Roman Ruins

BY FITTING together like a child's puzzle fragments of a stone tablet, French archeologists recently solved a 1,200-year-old riddle of the ancient Roman city of Timgad, Africa, destroyed by the Arabs in A.D. 429. In the ruins they unearthed a fragment which indicated that a man whose name began with "Ro" had given 400,000 sesterces (about $20,000) for some purpose. A second fragment, found four years later, indicated that the building had been used for a purpose designated by a word ending in "otheca." Archeologists supplied Latin words that fitted the missing part, which when found proved they had filled in the inscription correctly. The stone tells that a Roman citizen, Marcus Julius Quintianus Flavius Rogatianus willed the money to his native town to found a bibliotheca—a library.

Moon's "Rays" Still a Puzzle

MYSTERIOUS bright "rays" observed whenever telescopes are pointed at the moon are puzzling astronomers, according to H. G. Tomkins, English scientist, who is building a special reflecting telescope in an effort to determine their significance by photographing them at all possible angles. That they may be light lines of whitish dust, shallow cracks in the ground, or sulphur streaks from extinct volcanos, has been suggested, but Tomkins doubts these theories.

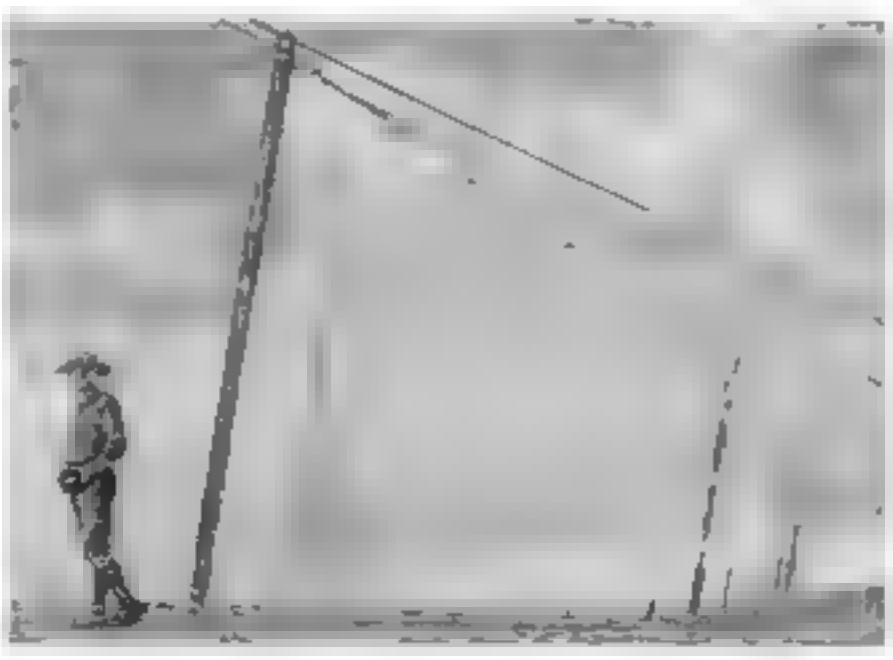
A World-Wide Radio Clock

ONE clock to beat time for the world is the remarkable proposal of Prof Arthur Korn, noted German inventor of a radio picture transmitting process. From some central observatory its ticks would be broadcast instantly by radio to the whole civilized world, giving a single, accurate time. Through such a plan, advocated by Dr. Albert Einstein and other world-famous savants, clocks throughout the world would be brought to agreement as close as one one hundred thousandth of a second. Elaborate plans of Prof. Korn include the use of television devices to synchronize the earth's clocks with the master timepiece.

At present each country sets its clocks from its own national astronomical observatory, by radio and telegraph, and between clocks of various countries, Prof. Korn points out, there is often a discrepancy of a fifth of a second. To the layman this is unimportant; but astronomers and others need a universal time.

New Arc Welding Marvel

TORRENTS of electrons purify metal and assure a perfect joint in the latest electric arc welding process, developed by a Cleveland firm. It employs an electrical phenomenon considered upon its discovery a mere laboratory curiosity; but which, put to work, gives the welded part of the metal the same strength and ductility as the plates joined. Heretofore the greatest welding difficulty was to avoid burning the metal or depositing a brittle layer. Freight cars, oil cars, pipe lines, and steel buildings will be built more cheaply by the new "electronic tornado" process, it is predicted.



Networks of grounded wires cover reservoirs of three California oil companies, providing additional protection to that of lightning rods

Wire Nets Defy Lightning

AS A protection against lightning three Pacific Coast oil companies have installed systems of grounded wire networks over their oil reservoirs, in addition to 200-foot lightning rods, as seen at the left. The towers protect against direct strikes, while the network is supposed to carry off any induced charge, keeping it off the reservoir and providing a good metallic path for its passage to the ground. Fires started by lightning have entailed losses of millions of dollars.

Answers to Your Questions

POPULAR SCIENCE MONTHLY is glad to answer, whenever possible, readers' questions on any subject within its field and to supply names and addresses of makers of devices described in the magazine. Inquiries, inclosing stamped, self-addressed envelopes, should be sent to Information Department, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.

On a large, low pedestal of artistic form in Potsdam Platz, Berlin, has been placed permanently a large map of the city, protected by a glass covering. Within a few months it has guided many visitors

City Map in Public Square

TOURISTS and out-of-town visitors would be able to find their way around better if they could inspect a large, detailed map of the city. So argued the authorities of Berlin, and ordered such a map installed in Potsdam Platz and covered it with heavy glass to prevent mutilation. It has been consulted by thousands of newcomers to the German metropolis since its adoption.

"Soundless" Police Whistles

WHISTLES whose notes are far too high-pitched for the human ear to hear have recently been supplied to policemen in virtually all large cities in France. Equipped with one of these alarms, an officer who observes a burglar at work can summon reinforcements without alarming the suspect.

Microphones, skillfully camouflaged throughout the city, pick up the inaudible sound waves and flash the alarm to Central Police Headquarters. The officer in the street can direct the sending of aid in Morse code through the use of his soundless whistle. A somewhat similar system has been in vogue in Germany, where such "ultra-whistles" have been used to summon police dogs that can hear them, though human beings cannot.

Geysers Found in Nevada

NEVADA, too, has its geysers, it has just been announced. They were discovered last summer by Prof. C. T. Brues, of Harvard University, and his wife, who were making a motor trip across the Nevada desert regions. Greatly to their surprise, the motor tourists came upon a small patch of erupting hot springs whose craters were much like those of the world-famous Yellowstone National Park geysers in Wyoming.

Hitherto Yellowstone National Park, which contains more natural geysers than all the rest of the world put together, was thought to be the only place in the United States where they were to be found. Iceland, which gave the odd boiling springs their name, and New Zealand also possess famous geysers.

These scenes indicate the life of 1978 as conceived and illustrated at a recent exhibition in London. Living in something like bathing suits, people bathe almost constantly under ultra violet lamps. Every family has a limousine airplane. All rooms face south and the houses will have movable walls and flower gardens

How Much Do You Know Of the World You Live In?

TEST your knowledge with these questions, chosen from the hundreds our readers send in. The correct answers are given on page 115.

1. What game like basketball was played by ancient Americans?
2. Where do angostura bitters come from?
3. Where does Cayenne pepper come from?
4. Where is radium mined?
5. Why is the Labrador coast so cold?
6. What is "The Rainbow Turned to Stone"?
7. What are the greatest waterfalls in the world?
8. What country has the most earthquakes?
9. Where is there a lizard that resembles the ancient extinct dinosaurs?
10. What lake apparently is devoid of living creatures?
11. Where has soil erosion destroyed much land?
12. Where is the Great Dismal Swamp?

How Folks Will Live in 1978

HOW people may look and live fifty years hence, with customs strangely changed from those of today, was recently visualized at an ideal home exhibition in London, where these photos were taken.

According to the designers' theory, the home of the future will be so constructed that all rooms will have the desirable southern exposure, regardless of the house's position with relation to the street. Interchangeable walls will be moved by pressure of buttons. Color schemes and flower beds can be shifted. Eating from cartons, destroyed after use, will dispense with dish washing. Each family will have a limousine-airplane.

For convenience and better health, people are expected to live customarily in garments not unlike bathing costumes of today, and to bathe more or less constantly under huge electric lamps shedding the health stimulating ultra-violet rays.

Know Your Car

YOUR automobile motor is a heat engine. It is the heat of combustion that drives it But with the gasoline motor, efficient as it is, a considerable amount of heat is wasted. This heat goes into the cylinder walls, cylinder head, and the moving metal parts, and if it remained, the motor would quickly become so hot that it would cease to run.

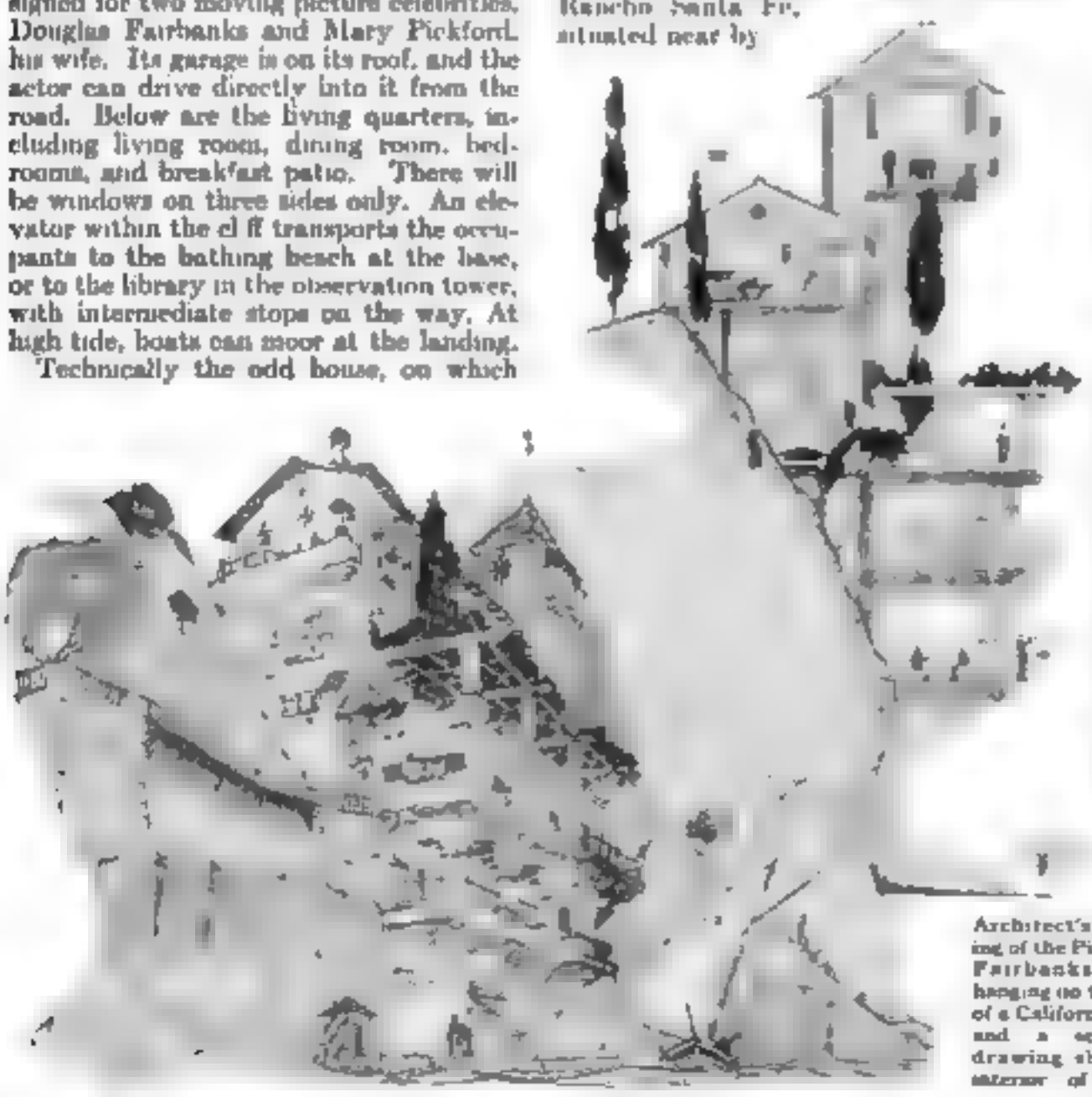
The water jackets on the cylinders, the radiator, the fan, the pump, and several gallons of water take the heat from the cylinders and get rid of it by heating the air that passes through the radiator. Anything that impedes this heat transfer will interfere with the cooling system. Dirt, scale, and rust slow down the heat transfer. Make sure—particularly in hot weather—that the cooling system is cleaned occasionally, that the fan belt is tight enough, and that the radiator is kept filled with clean water.

House Clings to Cliff Side

A HOUSE tailored to fit a cliff, and supporting itself by its own sheer weight against the rock face, is the unique seashore home at Solona Beach, Calif., that William Cameron Menzies has designed for two moving picture celebrities, Douglas Fairbanks and Mary Pickford, his wife. Its garage is on its roof, and the actor can drive directly into it from the road. Below are the living quarters, including living room, dining room, bedrooms, and breakfast patio. There will be windows on three sides only. An elevator within the cliff transports the occupants to the bathing beach at the base, or to the library in the observation tower, with intermediate stops on the way. At high tide, boats can moor at the landing.

Technically the odd house, on which construction is soon to commence, is called a cantilever structure, and it is said to be solidly based, despite its top-heavy appearance. It is patterned as shown below, after houses abroad that overlook Swiss and Italian lakes. Douglas Fairbanks brother Robert Fairbanks, who was a noted consulting engineer before entering the motion picture industry, is said to have contributed advice in its mechanical design.

The house will be a show place of Solona Beach but will be only a dilatory domicile for the motion picture stars, whose main residence will continue to be Rancho Santa Fe, situated near by



Architect's drawing of the Pickford Fairbanks home hanging on the side of a California cliff and a sectional drawing showing interior of house

Auto in Use for 37 Years

REMARKABLE staying powers of some of the pioneer automobiles is evidenced by a French machine that is thirty-seven years old and still going strong. The car is owned by the priest of a little French village, and has traveled faithfully more than 800,000 miles in its long and useful life. A one-horsepower engine drives the queer old contraption over hill and dale and cobblestone streets. The gasoline tank is located over the engine, while the radiator is in the rear.

120 Millions of Us Now

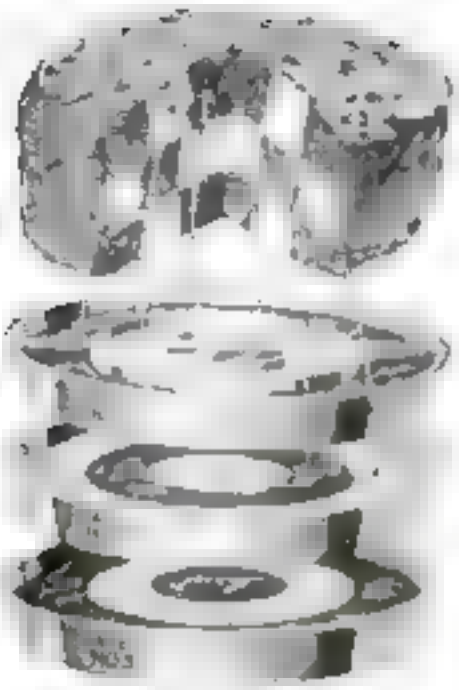
BY JULY 1, 1928, the United States will have 120,013,000 inhabitants, according to the latest estimate of the U. S. Census Bureau—an increase of nearly fifteen million since 1920. New York leads the states with more than eleven million, while Nevada is last with 77,407 persons.

Boring Huge Telescope Glass

SOON the U. S. Bureau of Standards will undertake the ticklish job of boring an eight inch hole through the center of the largest disk of optical glass ever cast in America, and the most perfect in the world. When no commercial glass worker in the United States could be found who would risk preparing the giant glass for its place in the Ohio Wesleyan University's new reflecting telescope, Government experts decided to perform the work themselves. They had already manufactured the disk after great firms had balked at the order, an achievement illustrated in the May POPULAR SCIENCE MONTHLY

Due to the unique way in which the seventy-inch disk was made, A. N. Finn, chief of the Bureau's glass section, anticipates little difficulty in boring it. Its gradual cooling, under electric control, for eight months after it was cast has effectively relieved it of any internal strain that might imperil it in the cutting process, he says.

Helpful New Tools



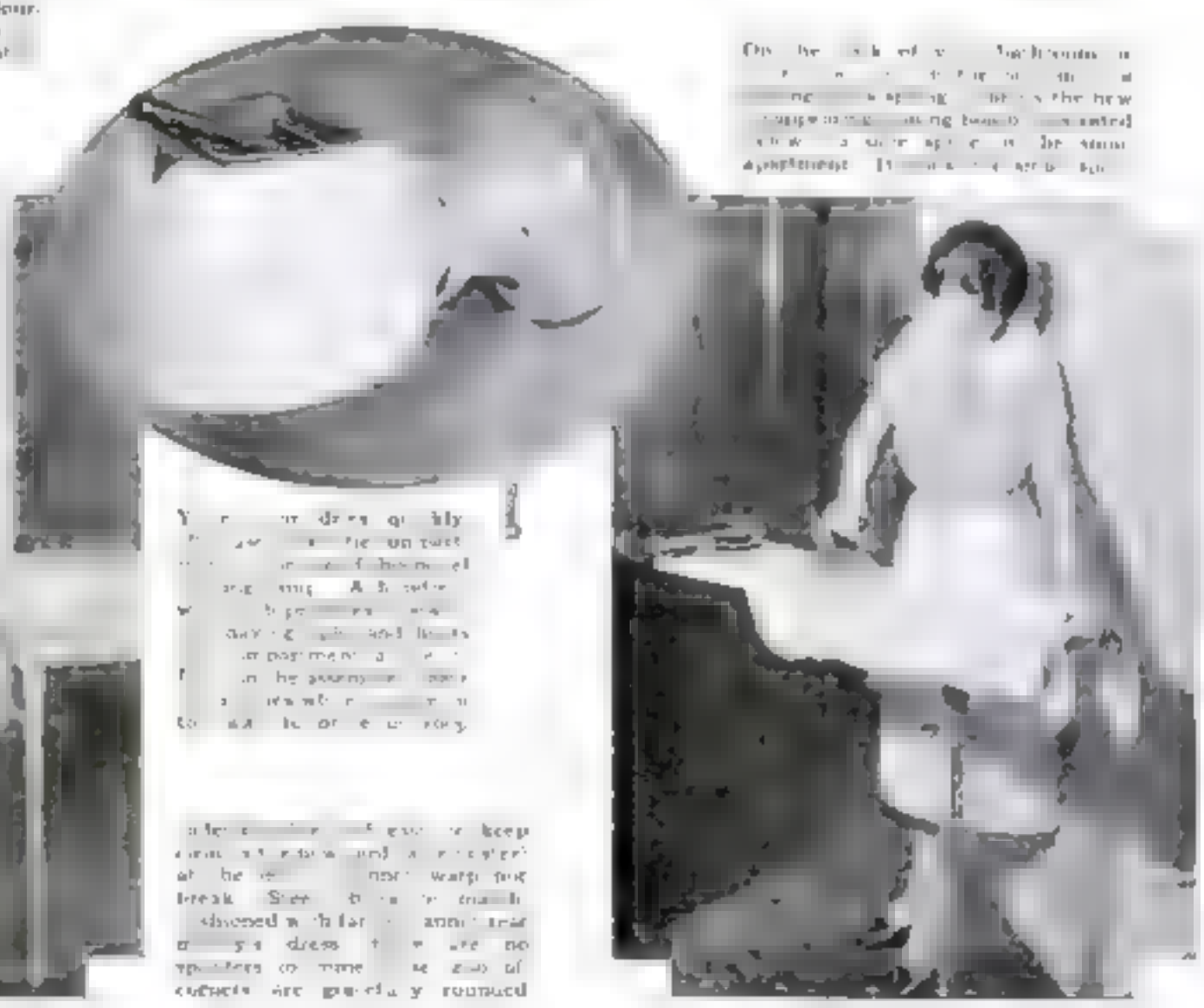
It's simple to make this novel "checkerboard" cake, for a set of three cake pans holds the separate layers. In each layer the ingredients are arranged in ring containers

Despite the compact up-and-down shape of a new electric dishwasher it can wash all the dishes of a family of ten or twelve. Within its capacious interior torrents of hot soapy water spray the plates clean. It requires a minimum of kitchen room, and uses even this to best advantage for with the top closed it makes a handy table

A new holder of sponge rubber keeps your soap in place and serves efficiently to keep your washstand neat. The holder also makes a good sponge

A view looking down on the dish washer showing arrangement of dishes in rack that holds them stationary

Sifting flour with one hand is easy in this new kitchen device. At a pressure of the handle a wire "fork" agitates the flour.

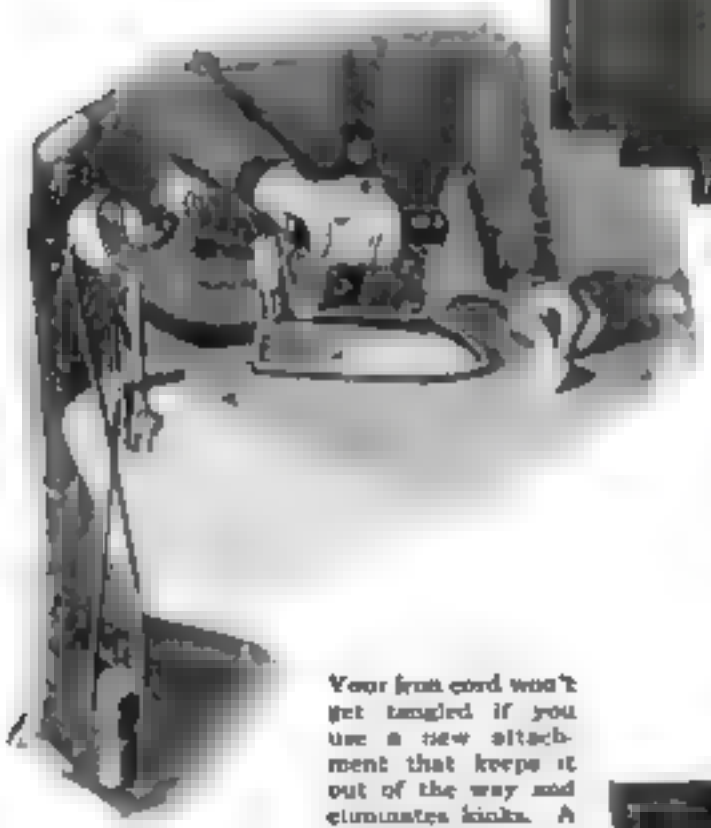


in the Household

Making the most of limited closet space is possible with these new hangers for coats and skirts: their long, broomstick-like handles enable you to hang clothes on high hooks ordinarily far out of reach

Lying in bed you can study or read in comfort with the new illuminated reading stand shown below, made expressly for the purpose. It carries its own lamp, and clips are provided to hold a book or magazine open to the desired place. The reading shelf is adjustable in a second, with no screws to be tightened, to any height

Exercise from the light socket is possible, says the maker of a new electric device that gives you a healthful massage while you stand or sit with its vibrating belt encircling you. You can set it on a light table, window ledge, or dresser



Deep dish pies of meat or fruit—are baked with a crust that won't fall or become soggy in a novel pie pan that has three perforated metal pieces to support the crust. When the pie is done, you slide out the crust supporters by the meat hooks at their ends

Now you can spray paints, varnishes, light lacquers, and enamels on furniture, says the designer of two new household outfits at the right—one that works by hand and another electric. A few strokes of the hand pump and you have a tank of air ready to spray, or you can turn a switch and let the motor do the rest. Interior decorating becomes a pleasure

Your iron cord won't get tangled if you use a new attachment that keeps it out of the way and eliminates kinks. A weighted pulley takes up the slack and also makes the return stroke of the iron easier, for the weight does part of the work of your arm

Meat for Swiss steak is separated conveniently without being crushed or torn, it is said, by a new metal tool of many prongs. It does not bruise the meat as does pounding or chopping, and the juice remains, as it should, to make the roast more savory

Bulky jar tops come off with the aid of a new cap remover made of rubber. Its threaded inside grips the cap and makes removal easy—one or two turns, and the cap is free. Two raised finger grips keep your hand from slipping, even with stubbornest caps

Get out! That is what Congress says to some broadcasters, but who is going? That must be determined by the licensing authority. How would you go about it?

What Would You Do If You Were Czar of Radio?

BY NO stretch of the imagination is it possible to run six cars abreast on a road only wide enough for four. It simply cannot be done. And yet that, in a nutshell, is just what radio broadcasters are trying to do. Several hundred stations are broadcasting in a band of wave lengths only wide enough to accommodate about ninety stations.

As a radio listener you know the result. Squeals, whistles and distorted grumblings. If you are lucky you may perhaps, succeed in tuning in a distant station properly but the chances are against you.

It wouldn't be so bad if the whistles and squeals were confined to distant stations, because you could listen to local stations exclusively. However, stations operating too close to the same wave length in many cases spoil local reception with whistling noises.

Congress has passed an Act which eventually will result in the overhauling of the whole broadcasting situation from stem to stern.

THE drastic provisions of the new law are contained in Section 5: "It is hereby declared that the people of all the zones established by Section 2 of this Act are entitled to equality of radio broadcasting service both of transmission and reception and in order to provide said equality the licensing authority shall as nearly as possible make and maintain an equal allocation of broadcasting licenses, of bands of frequency or wave lengths, of periods of time for operation and of station power, to each of said zones when and in so far as there are applications therefor; and shall make a fair and equitable allocation of licenses, wave lengths and time for operation and station power to each of the states, District of Columbia and the territories and possessions of the United States within each zone according to population."

Briefly, this means that the number and total power of the broadcasting stations must be divided equally among each of the five zones indicated on the map shown on this page and that within the zone the distribution of broadcasting stations must be in accordance with the density of the population. There is nothing in the law as to the total number of stations. That is a matter left in the hands of the Federal Radio Commission.

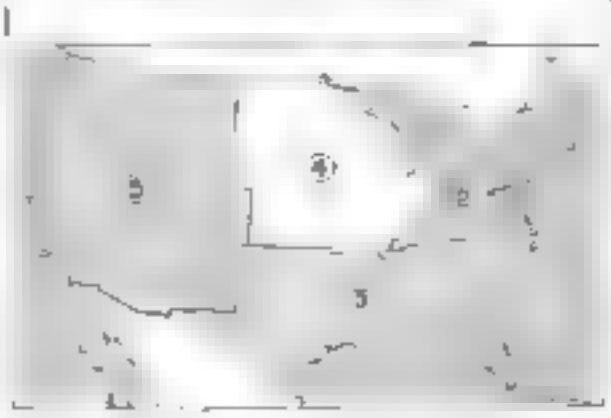
AT PRESENT the distribution of broadcasting stations, both in number and in power, does not at all conform to the new law. There are too many in some sections and too few, or none, in others. What is to be done about it? The Federal Radio Commission is trying hard to find the answer. Associations of broadcasting stations and groups of radio manufacturers are desperately struggling to work out some plan that will make broadcasting conform to the new law without trouble, confusion, and loss.

Many stations will have to be closed. Others will be greatly reduced in power. That is inevitable if the law is enforced, and, indeed, (Continued on page 136)

PRIZES FOR BEST LETTERS

Here is a chance to compete for three prizes totaling $85.

1. **Imagine you have been appointed supreme authority over radio broadcasting.**
2. **Figure out what, in your opinion, would be the best plan to make broadcasting conform to the new law, the object of which is to make broadcasting of the greatest service to the maximum number of people.**
3. **Write out your plan as briefly and clearly as you can and mail it to Radio Contest Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City, so as to reach this office by July 15, 1928.**

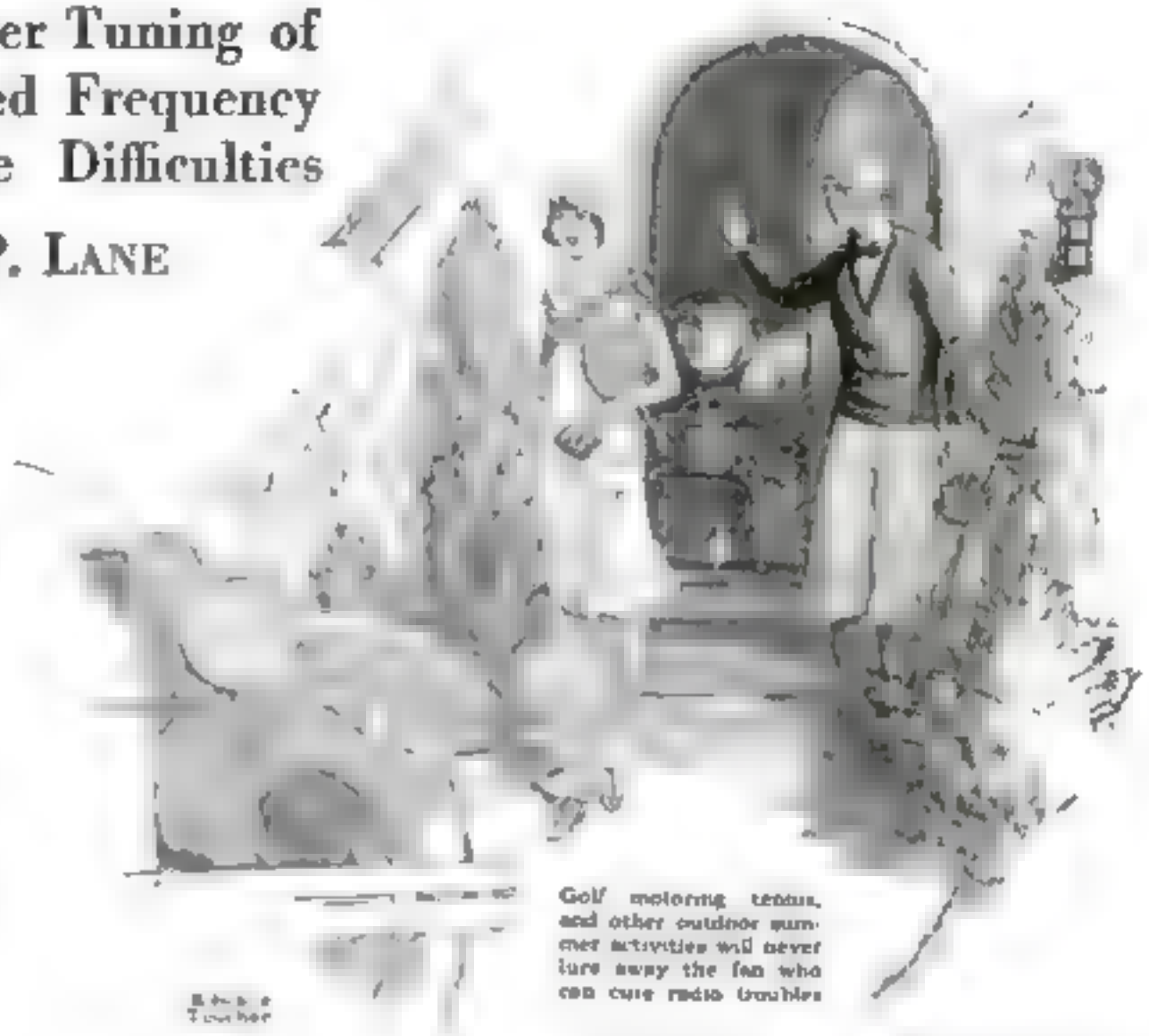


The five zones into which the nation is divided by Congressional act in the first step toward ending the confusion and confusion of radio broadcasting

Radio Hints for Summer Use

Wave Traps, Sharper Tuning of Antenna, and Tuned Frequency Amplification Cure Difficulties

By ALFRED P. LANE



Golf motoring tennis, and other outdoor summer activities will never lure away the fan who can cure radio troubles

RADIO loses some of its popularity in summer because it has to compete with so many other attractions. Motoring, golf, tennis, and other outdoor activities lure the radio fan away from his dial-twisting. There was a time, too, when with summer came a noticeable falling off in the quality of the broadcast programs. That situation, happily, no longer exists, although a few of the most popular program features disappear from the air during the hot weather.

The chief limitations on summertime radio are inability to bring in distant stations and a sharp increase in the amount of static interference.

Don't waste your money on so-called "static eliminators." Many such devices have come to the attention of the Popular Science Institute of Standards and have been carefully tested. In every case they have completely failed to perform the function for which they were designed. Some of them actually reduced the static noise, but wherever a reduction in static was noted, careful measurements showed that the strength of the broadcasting had been reduced exactly in the same proportion. In other words, equally good results could have been obtained merely by turning down the volume control of the set!

BUT while the radio fan who is a long way from the broadcasting stations must necessarily expect a curtailment of his radio listening with the coming of hot weather, most of us are located where there are one or more local broadcasting stations and we can enjoy the music and other entertainment from these stations.

The secret of satisfactory nightly reception of local stations in spite of hot weather static rests first in making sure that your radio equipment is in good condition. See that no noises generated within the set are being added to the noises that come in by way of the antenna. Hot weather is hard on batteries, both storage and dry cell type. Storage batteries need more water in hot weather and dry cells do not last as long. The sticky, humid air of summer that makes everything feel damp also causes surface leaks over the tops of the batteries, particularly if they are allowed to become dusty, and such leaks often are the unsuspected cause of frying and sizzling noises. This caution naturally does not apply to radio receivers of the full electric type.

There are tricks in all trades, even in radio reception, and the man who knows his set can often defeat static and weak signals in the summertime

Static seems to come in on all wave lengths. Occasionally you will notice that there seems to be more static on the shorter waves or perhaps, on the longer waves, but generally speaking static is untuned. No matter where you turn the dials on bad nights, the crackling and snapping noises come in just the same.

The broadcast wave is, on the other hand, very sharply tuned. It comes in strongest only at one point on the dial.

If your receiver tunes quite broadly you get the music from the broadcasting station together with the static that is coming in on that particular wave length plus the static on adjacent wave lengths. By making your receiver tune sharper you can cut out the static that comes in on these adjacent wave bands.

There are three practical ways to make your set tune more sharply. You can use a wave trap or even two wave traps in series. You can add a stage of tuned radio-frequency amplification if your set is of the plain, regenerative type. And you can improve matters by making your antenna tune more sharply. These methods of improving the selectivity of your radio receiver were discussed in an article which appeared in POPULAR SCIENCE MONTHLY for April, 1928. This article dealt with improving the selectivity from the standpoint of eliminating interfering stations, but it applies with equal force to eliminating static.

THE other peculiarity of static that will help you to ameliorate its bad effect is that it produces sharp crackling noises that have but little resonance. Once they are converted to air vibrations by the loudspeaker, they have poor carrying power. The resonant vibrations of music or speech, on the other hand, carry quite well.

This means that the farther away you are from the loudspeaker, the less the sound of the static interferes with the music. In other words, you can materially reduce the effect of static by placing your loudspeaker in another room or, in extreme cases, on another floor in your house.

Experiments conducted in the laboratory of the Popular Science Institute of Standards show that a definite improvement in results can be made in this manner. Obviously not much can be accomplished along these lines unless the radio receiver is fitted with a powerful amplifier, if the usual 201A tube is used in the last audio stage of the receiver you cannot obtain enough volume without distortion to afford clear reception at sufficient distance from the speaker.

The use of the 171A tube worked at maximum power is necessary and even more power is desirable.

A Budget of Wisdom for Radio Owners

Giving *the Grid* Tube a Shield

What Wire to Use at Various Points and Why

RADIO experimenters who are working with the new shielded grid tube find that as soon as an attempt is made to use more than one stage of radio-frequency amplification employing these tubes, difficulties are encountered in the shielding.

To get a high degree of amplification out of the 222 tube under these conditions, the shielding has to be very complete, otherwise the particular features of the shielded grid construction are of no value.

The illustration on this page shows a shield unit especially designed for the new tube. When properly fitted it completely shields the tube and the control grid wiring against any stray capacity effects. The composition ring is designed to attach to a standard type of socket and the copper bell fits down over the tube. A cap is supplied for the opening in the top of the copper bell and a special connecter, flexible grid wire, and flexible grid wire shield are a part of the kit. The ideal arrangement is to inclose the coil, tuning condenser, and vacuum tube in a heavy box shield and, in addition, shield the tube separately

The Right Kind of Wire

BEGINNERS in radio often are confused as to the proper wire to use to connect up the various parts in the radio receivers they are constructing and for battery, antenna, and loudspeaker connections.

For the internal connections of a receiver any kind of wire will give good results. It may be flexible stranded wire or solid bus wire. And any size from No. 24 to No. 12 can be used. But while there is no electrical advantage in using the larger sizes of wire, it naturally is easier to make a neat looking job if you use wire stiff enough to stay where you put it. If the internal appearance of the receiver is of no importance, use any wire that happens to be handy except iron wire. Iron wire should not be used because of the electromagnetic action.

B-battery connections also can be made with almost any size wire provided it is suitably insulated. The B-battery wires carry small amounts of current, but the voltage is as high, and in many cases higher, than the voltage in the electric light wires in your home. Rubber covered wire is desirable. The A-battery wires carry relatively larger amounts of current at much lower voltage. This means that very small wire should not be used. The size should be at least No. 16. While thin insulation is theoretically sufficient because of the low voltage, rubber covered insulation is safe because

The new 222 grid tube and the shield specially designed for it—a bell made of copper. A flexible grid wire and a shield for it are included in the kit

an accidental short circuit in storage battery wiring may result in a fire. The special cables sold for connecting the batteries contain a group of wires each of the right size and with the proper insulation.

The size of the wire used to connect the loudspeaker is of no importance. Very small wire would be ample to carry the current. However, loudspeaker cords must be of flexible wire so as to stand bending, and the insulation should be at least equivalent to electric light wire. In fact, if you want to make an extension for your loudspeaker cord, ordinary electric light drop wire is suitable.

Antenna connections to the lightning insulator should be of wire not smaller than the antenna itself and the ground wire should be not less than No. 14 size.

A B C's of Radio

A WORKING knowledge of the fundamental relation between volts, amperes, and ohms, the three basic units of electrical measurement, will prove useful to the radio beginner

The volt is the unit of electrical pressure; the ampere, of volume; and the ohm, of resistance. In any electrical circuit, the voltage or pressure is what forces the amperes or volume through the ohms or resistance

It takes one volt to force one ampere of current through a resistance of one ohm. Hence you can figure the current or amperes in any circuit by dividing the voltage or pressure by the ohms or resistance. Similarly you can figure out the resistance of any circuit by dividing the number of volts by the number of amperes. And if you wish to know how many volts would be required to force a certain number of amperes through a specified resistance, multiply the number of amperes by the number of ohms.

When Is a Tube Dead?

A VACUUM tube used in a radio receiver consists of a base, a glass bulb, a filament, a wire grid, and a plate. Assuming that the tube does not meet with an accident that breaks the glass bulb, the life of the tube is governed by the filament, which is the wire that is heated to red heat by the current from the A-battery or, in the case of alternating current type tubes, by the low voltage current from the filament heating transformer. The filament is coated with a substance which when heated produces a copious flow of electrons that travel from the filament through the grid to the plate. Excessive filament current will, of course, burn out the filament and abruptly terminate the usefulness of the tube; but if the tube is normally used, its useful life will be governed by the flow of the electrons from the filament.

After somewhat over a thousand hours of use, the electron flow from the filament will gradually cease and when it has fallen below a certain critical point the life of the tube is ended and it should be replaced with a new tube. The fact that the filament still glows when the A-battery current is turned on means nothing except that the filament is not burned out.

Light Socket Antennas

BEFORE you put up an indoor antenna for your radio receiver, it is a good plan to try out one of the special plugs, to be screwed in the lamp socket, that allows you to use the electric light wiring as an antenna. Frequently, the light socket antenna will give you better results than the ordinary indoor antenna and sometimes it will rival the results to be obtained from an outdoor antenna. You never can be sure, however, of results to be obtained from the electric lines as antennas because the location of the wiring in the buildings, its position in the walls relative to water piping and other factors has a material effect on its efficiency.

When You Plan to Build—

This Article Will Help You Solve Some of the Problems Faced by Everyone Who Wants a Real Home

By JOHN R. McMAHON

HERE Mr. McMahon, in a most interesting way, answers some of the questions our readers have asked him about building. Whether you plan to build immediately or not his construction advice should be valuable to you. And, if a knotty problem is troubling you, perhaps he can solve it for you. Or if there is a problem you have solved in an unusual way he'll be glad to know about it Address him in care of the Homebuilding Department, POPULAR SCIENCE MONTHLY, 250 Fourth Ave., New York City.

A FRECKLED-NOSE office boy with ears adapted to take in baseball scores made a sad blunder the other day in the Homebuilding Department of this magazine. He switched the contents of two outgoing envelopes so that the advice intended for a reader in Florida almost went to one in Alberta, Canada, and vice versa.

"This is a terrible thing!" exclaimed the editorial assistant, who caught the mistake just in time. "We pride ourselves on prompt accurate service to home builders. Here are a couple of readers all set to build or fix up houses and they want advice in a hurry; then they open the letters and find a lot of gibberish. Drat the boy! I ought to have known by his ears what he would do."

"It might not be a fatal mistake," I suggested. "Both readers wanted to know about insulation, and the advice to one applies fairly well to the other

"Why, the Canadian is freezing and the Floridan is sizzling! How can you doctor them both with one prescription?

"Ask the scientists," I laughed. "It is the same principle on which we insulate a steam pipe or a refrigerator Insulation is a wall that shuts out either heat or cold. It is a good thing in all climates, and everywhere it serves the same purpose of making a house interior comfortable. In the far South protection may be needed against heat; in the North against cold. The same insulation may serve either purpose equally well."

The insulation of houses is a comparatively new idea, and many persons are seeking light on the subject. Here are some typical queries and answers.

Does a well built house in a temperate climate need insulation?

Yes, if well built means just standard sound construction. Even a palatial dwelling with walls of extra thickness and multiple air spaces, as a combination of special hollow tile, brick outside, and gypsum or tile furring blocks inside, can be insulated profitably as to attic floor and roof to shut out summer heat rather than winter cold. But the ordinary house is attacked by hostile temperatures on all sides and needs complete protection. Insulation also prevents condensation of interior moisture, stops drafts, and equalizes temperature, thus becoming an important health factor.

An incinerator apartment building size, with part cut away to show construction air space between the outer wall and the lining made of fire brick

HOW many kinds of insulation are now available?

Two dozen or so, ranging from powders, loose fibers, quilts, and slabs to wall boards. The powders are gypsum or other minerals in a fluffy state that create a multitude of air chambers and the material may be used dry or wet. The dry powder is filled in an inch or two in depth between ceiling beams, or in a plastic condition is poured and spread like mortar Loose fibers refers to mineral wool, which is the worked-up slag from ore furnaces. Over ninety percent of its bulk is captive air, which is the basis of all insulation. It can be spread economically under

Copper flashing between roof and wall, as well as around chimneys, costs little more than zinc or tin and is far more effective and durable

top flooring, but is somewhat expensive as a filler between studs because of the quantity required. There is obvious fire protection and vermin proofing with all mineral insulators

What are the quilts made of?

THE quilts include flax, hair felt, eelgrass, wood, and other vegetable fibers inclosed in treated paper or burlap. They are made in convenient rolls and may be laid between floors or tacked between or across studs and rafters. The wall boards are composed of the fibers of sugar cane, wood, rye or wheat straw, and other combinations. These are most convenient to apply, since they are four feet wide and room high. They should not be confused with the smaller sized and otherwise different plaster boards or hard compressed pasteboards. Finally, we have slabs of cork board, which is ground cork pressed in molds and baked. The slabs are not large. They are nailed to studs or rafters and also "glued" with mortar to the inside of masonry walls.

Which is the best of all the insulators?

A mineral powder, followed by mineral wool and hair felt. However, there is not a great difference between the majority of the substances, provided the thickness is the same. For the better materials the twenty-four-hour heat loss in thermal units through a square foot an inch thick per degree difference in temperature is about six, while the others run from seven to eight. An inch of insulation about equals an average house wall. Bear in mind the importance of thickness when making a selection and also the labor cost of application. While the minerals are wholly proof against fire, vermin, and decay, the treatment of most vegetable fibers or their inherent qualities make them fire resistant and very durable.

What is the insulating value of lath and plaster, gypsum wall board, and hardwood fiber board?

Not much compared to the substances mentioned, although each may be desirable in combination with the other material. An easy if rough way to distinguish an insulator is by porosity and lightness. This applies even to lumber, so that any soft light wood insulates better than hardwood. Thus cypress scores a heat loss of sixteen thermal units and white pine nineteen against twenty-four for oak and twenty-seven for maple. Cedar is probably close to cypress, which is a good thing in view of the wide use of cedar for siding and shingles, adding as it does some insulation value to the decay-resistant properties of that wood.

Wall insulation is generally used. This may be made of fibers of sugar cane, wood, rye or wheat straw, and a variety of other materials

We are planning a house to cost $12,000. The architect specifies tin flashing for chimney and two roof valleys. Is that right?

No, and the architect should know better. Tin or galvanized iron are very perishable unless painted on the underside with red lead and repainted on top every two or three years. Copper should cost no more to place and it lasts indefinitely without any attention. Tin or galvanized flashing sheets are about twelve cents a square foot while copper is thirty. The difference in material price for the whole job is about fifteen dollars. Zinc is better than tin and costs little more, but cannot be used with wood shingles. It has a low melting point compared with copper and is therefore less desirable from the standpoint of fire safety.

WHAT is the method of attaching new flashing to an old chimney?

The mortar is chiseled out in horizontal lines between the bricks. The edges of the metal sheets are partly crimped and driven into the spaces between bricks, after which the joints are "pointed up" with fresh mortar. Instead of filling with mortar, the joint may be calked with lead wool. The fastened sheets or strips are turned down to overlap their neighbors sidewise and also the flat sheets previously fitted around chimney and nailed close to brickwork. The turned-down strips are not nailed at the bottom, which avoids holes and allows for expansion or movement.

Would you advise ultra-violet glass, which costs $135 more than ordinary window glass, for a bungalow in southern California?

A land of sunshine where people can be outdoors all the time and obtain unlimited quantities of complete solar rays directly needs less of such glass than a gloomy climate. Schools and office buildings, cities and built-up suburbs have the most use for the fused quartz composition glass. If the bungalow does not need $135 for fundamental features, that amount may be wisely devoted to the new kind of glazing, otherwise, equip only two or three rooms, as kitchen, bedroom, and children's playroom.

Insulating materials for sheathing walls, made of flax, felt, celgrass and other substances impede passage of heat and cold. They come in sheets, rolls, and slabs

Is it true that substitutes for this glass become less efficient in time?

Some do, according to Bureau of Standards tests reported in detail in the May POPULAR SCIENCE MONTHLY. The tests are not yet complete.

Are low efficiency substitutes for this glass worth having?

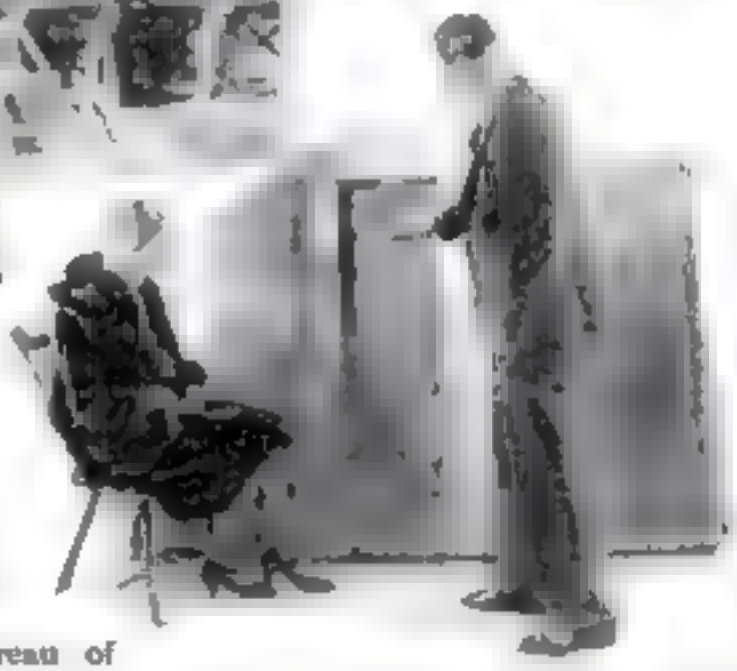
If its latter condition is stable we may assume the glass is worth while provided the price is proportionate to the more enduring varieties. The thinner the glass the better it transmits ultra-violet rays, and for this reason some types are made with a thickness less than one-twenty-fifth inch, half the thickness of ordinary single strength window glass. Small-paned sashes are requisite to avoid breakage.

We are building a summer bungalow with a living room of twelve-foot ceiling. The outside end wall, shingled on horizontal sheathing and two by four studs, is wobbly. The carpenter says the architect should have specified two by six studs. What is the remedy?

The carpenter is right, as he often is in practical issues while the architect is dreaming over form. The two by six is about fifty percent stronger than the two by four. Another contribution to rigidity would have been diagonal sheathing—a substantial advantage with relatively low extra cost. I would suggest that the wobbly wall be reinforced from the inside with a two by six or two by eight placed crosswise and about halfway between floor and ceiling. This reinforcing timber may be disguised as an ornamental shelf. The crosspiece may be notched to fit into the studs and spiked to them.

IS IT necessary to consider shrinkage of lumber in framing a house, and how much does that shrinkage amount to?

It is indeed necessary. If this point is disregarded and unseasoned lumber is used, the center of the house may settle a couple of inches below the level of the foundations. This will crack plaster, make doors stick, open joints in woodwork, and perhaps make the roof leak. Even seasoned lumber shrinks, although to a less degree. With proper framing the inevitable shrinkage is uniform and the settlement even, without noticeable consequences. Shrinkage occurs across the grain, as through the depth of a joist, and not endwise or in the long dimension. We must arrange sill, girder, and floor joists to equalize the depth of shrinkable wood between center and outside walls of the house. Thus if outside studs stand on a ten-inch sill or subfloor over floor joist, the inside partition studs should stand on the ten-inch girder, not on the floor joist above, which would double the shrinkable material at the center compared with the outside.

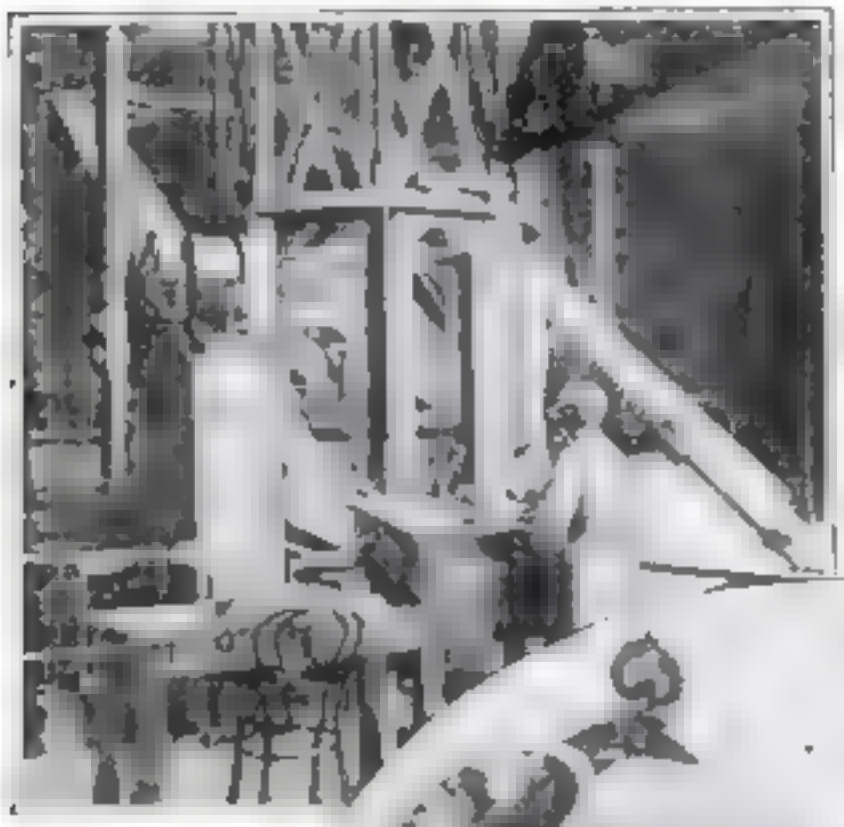


Studying flooring samples. Left to right: Comb grain North Carolina pine, select quarter sawed parquet oak (best of the four), maple, and plain oak

Is there more than one method of allowing for shrinkage or settlement?

Yes, there are (Continued on page 135)

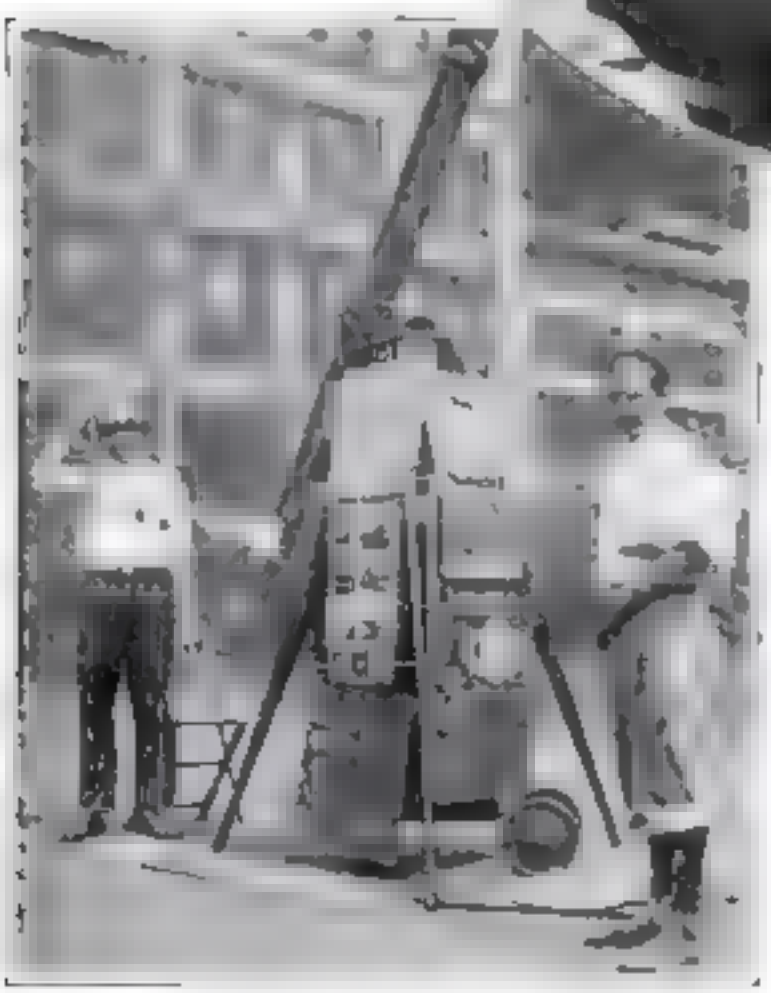
Strange Ways of Studying Stars



Standing before a small control panel in the Mt. Wilson, California, Observatory, the astronomer points the 100-inch reflecting telescope, largest in the world and 100,000 times as powerful as the human eye, at any star in the heavens simply by pushing different buttons. Forty electrical motors rotate the 100-foot dome, open a twenty-foot shutter, and raise and lower the 100-ton telescope skeleton

Amazingly accurate were the predictions of eclipses of the sun and moon made by the ancient Maya find an astronomers, who devised a calendar system of their own, perhaps as long as a thousand years ago, and foretold the coming of the equinoxes. Their age-old stone observatory in Central America, now in ruins, was the center of "the greatest intellectual achievement of ancient America," according to Dr. Sylvanus Griswold Morley, of the Carnegie Institution

Atop the ancient wall around Peking, China, are the remains of queer astronomical instruments used by early Chinese star gazers. Small circular projections are supposed to represent various heavenly bodies in the massive stone globe. During the Boxer Rebellion the weather beaten relics were seized by the Germans, but later were returned

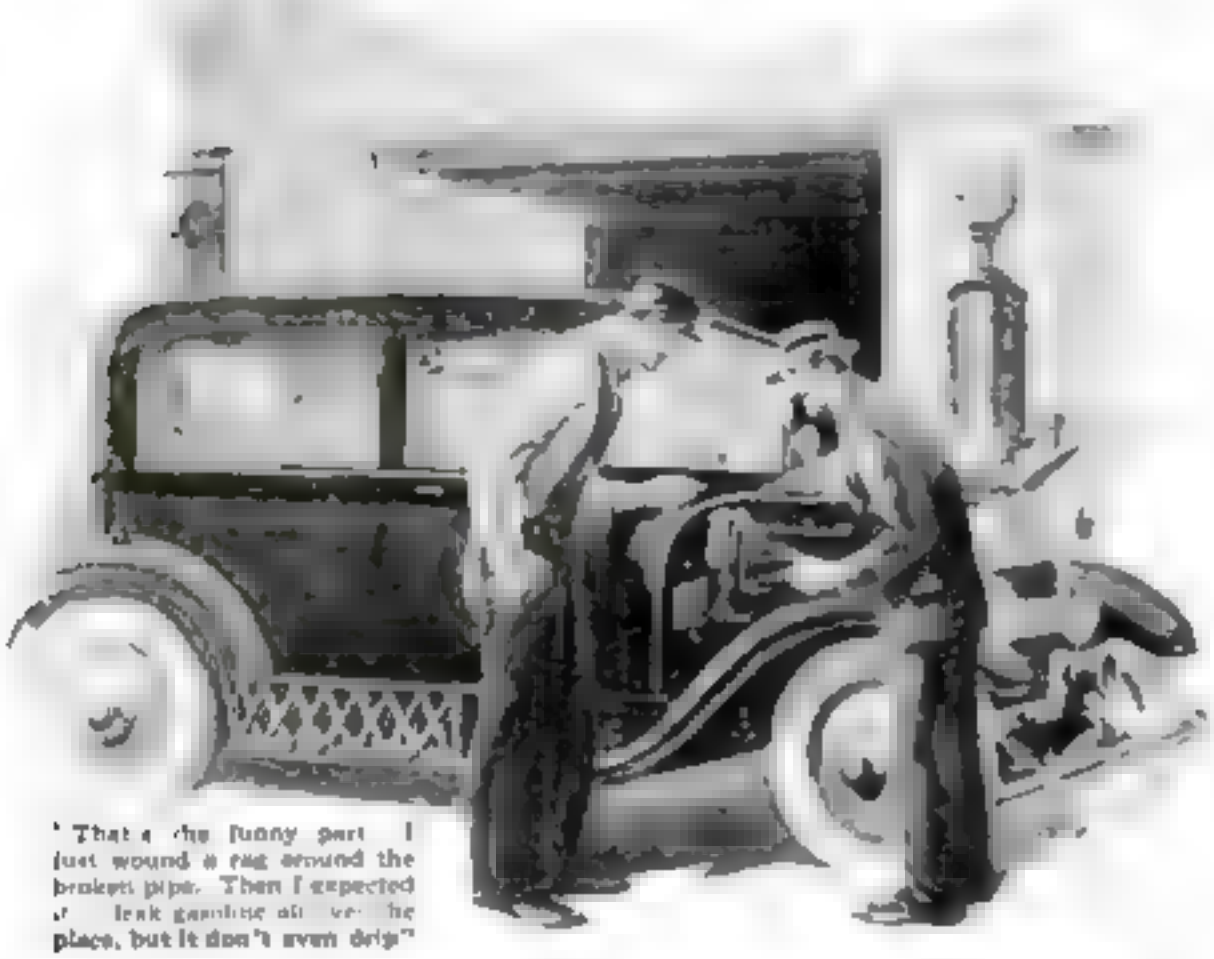


For a dime you may gaze through one of these sidewalk telescopes at almost any large city at the full moon, the evening star, or perhaps a neighboring planet. Saturn's rings or Mars, mysterious canals will be pointed out on clear nights

Here we see two Indian water boys who are guarding over the remains of queer apparatus used by Hindu astronomers at Jaipur, India, hundreds of years ago. In the background can be seen a curiously shaped tower which was probably used by the Hindus as an observatory at a time when the last of the thirteen colonies was just being settled in America

How "Bootleg" Gas *Ruins* a Car

Gus Tells Why You Can't Save Money by Buying Cheap Fuel and How You Can Guard Against Roadside "Gyps"



"That's the funny part. I just wound a rag around the broken pipe. Then I expected a leak gasoline all over the place, but it don't even drip"

By MARTIN BUNN

"HERE'S another long distance flyer down with a busted oil pipe!" exclaimed Joe Clark in the noon hour as he sat with the morning paper in one hand and a huge piece of chocolate cake in the other. "Those airplane motor manufacturers must be awful dumb if they can't even fit the oil pipes so they'll stay put."

Gus Wilson, veteran automobile mechanic and Joe's partner in the Model Garage, snarled sarcastically.

"Wake up, Joe!" he jeered. "Don't you know the poor old oil pipe always gets the blame when anything happens to an airplane motor? Of course the oil pipe can break, but lots of times it's just a phoney excuse to cover up a broken part in the motor."

Gus was interrupted by the persistent honking of a most peculiar motor horn. "I'll bet you two cents that's Bill Craddock with another of his contraptions," he grumbled as he snapped the lid on his lunch box and started out.

Joe grinned. "Tell Bill if he puts much more junk on that bus there won't be any room for passengers," he called after Gus.

"How's that for a warning signal?" Craddock shouted in greeting. "Sounds like a cow or something, eh? It's only a tin flap over the horn, and when I pull the wire the flap lifts up.

"But," he continued, "that isn't what I came here for. I nearly didn't get here at all. The gasoline pipe busted on me and I had to tie it up with an old rag. And the battery nearly quit before the motor started again."

The supply pipe from the main gasoline tank had broken off short where it entered the connection on the vacuum tank.

"Runs all right, now, it seems," said Gus as he fingered the rag winding.

"THAT'S the funny part of it," agreed Craddock. "I just wound the rag on because I didn't have anything else handy. I expected it would leak gasoline all over the place, but it's not even dripping. What made the pipe break in the first place and how in tophet ran gasoline flow through there without running out through the rag?"

"Gasoline pipes—and sometimes oil pipes," Gus explained with a meaning glance at Joe, who had joined them, "break because the metal gets tired. In other words it crystallizes. A complete break like this one is rather rare. Lots of cars go all the way from the factory to the junk yard without breaking an oil or gas pipe. I'm not counting leaks due to loose connections, burn soldered joints, and so on. You can't blame them on the pipe."

"And," he went on, "the reason gasoline didn't leak out is because it only goes through when it's sucked along by the vacuum tank. In fact, the rag served to keep air from leaking into the pipe fast enough to spoil the vacuum, not to keep the gasoline from getting out. If that had been the pipe from the vacuum tank to the carburetor, you'd have had a steady stream of gasoline running out."

"Then it's a good thing that pipe didn't bust," said Craddock. "Seems as though you can't carry enough tools and accessories to fix everything."

"No one could do that," Gus said. "Might be a good idea to put a package of chewing gum or a cake of laundry soap in the tool box, though. You can make a good temporary repair on a broken gas or oil pipe with a thick layer of gum or soap, bound with a rag or friction tape. A roll of friction tape and a spool of iron or brass wire ought to be in every tool kit," he finished as he set to work to fix the pipe.

"What made it start so hard after I got the pipe tied up?" Craddock questioned.

"The motor started hard because the vacuum tank was empty," explained Gus. "Of course, air leaking through the rag kept the tank from filling as fast as it otherwise would, but it takes quite a little cranking to get the tank full even when there's no leak. You could have saved the wear on your battery by priming the vacuum tank."

"THAT'S one on me," confessed Craddock. "And I know the right way to prime it, too. Just take off the pipe from the vacuum tank to the manifold and suck on it till the tank fills up. Isn't that the best way?"

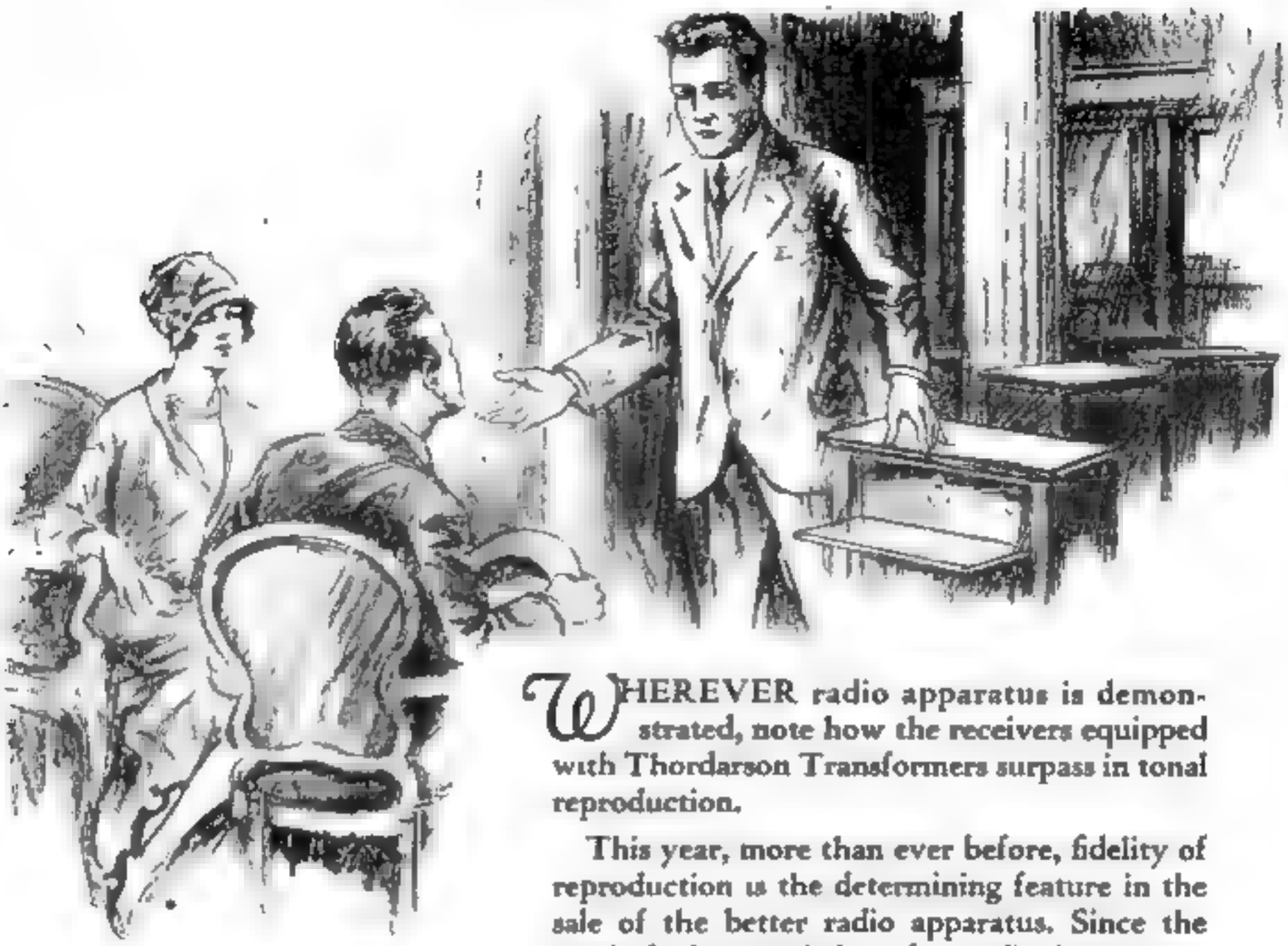
"A few years ago I'd have said yes, but now I'd say no," Gus replied. "There's always a chance that you might draw some of the gasoline into your mouth if the tank is on the bum, and you get the fumes in your lungs anyway. These new special fuels are fine food for motors, but some of 'em are poison for men, so it isn't wise to take a chance. If you haven't a spare can of gasoline handy, you can syphon off some from the main tank by dropping a length of rubber hose in the tank, pressing your thumb over the end, and pulling it out and down into the small can."

"None of that fancy stuff for me," Craddock snorted. "I buy plain, ordinary gasoline. And I get it just as cheap as I can. Gasoline is just gasoline and that's all there is to it!"

"DON'T you believe it!" Gus exclaimed. "There's real good gasoline, ordinary gasoline, and rotten gasoline. Cut-price gasoline is almost sure to be rotten. And you can get stung even when you pay the full price."

"That's the bunk!" jeered Craddock. "You can't fool me. There's cheap gasoline in that tank and yet the motor is running about the same as usual. It doesn't knock any more than it ought to, considering it's full of carbon. I'm going to clean it out next week and then it won't even knock."

"It's your car," admitted Gus patiently, "and you can (*Continued on page 113*)



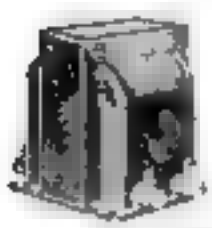
WHEREVER radio apparatus is demonstrated, note how the receivers equipped with Thordarson Transformers surpass in tonal reproduction.

This year, more than ever before, fidelity of reproduction is the determining feature in the sale of the better radio apparatus. Since the musical characteristics of a radio instrument depend to such a great extent on a wise selection of the audio and power supply transformers, it is significant that so many leading manufacturers have turned to Thordarson as the logical transformer source.

Equally significant is the fact that not once since Thordarson transformers became available to radio manufacturers has any other transformer approached the manufacturer popularity of Thordarson

These quality instruments are Thordarson equipped:

Zenith
Sparton
Howard
Pilot
Willard
Kennedy
Gilfillan
Kennedy
Neutrowound
Prest-O-Lite
Radiodyne
Buckingham
Murdock
Walbert
Argus
Audiola
Erla



THORDARSON

RADIO TRANSFORMERS

Supreme in musical performance

Thordarson transformers are universally available to custom set builders as well as manufacturers. Wherever radio parts are sold, there you will find a complete stock of Thordarson Audio and Power Supply apparatus. If you are building for real musical performance, insist on Thordarson Transformers.

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Transformer Specialists Since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
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This mat on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Useful Ideas for Your Car

Lifting Car Off Springs—Dented Fender Smoothed—New Battery Cover—Guard Saves Bumper Clever Oil Filter

AN ORDINARY iron C-clamp proves serviceable in many cases in removing dents from automobile fenders. To prevent damage to the finish, a wooden block of suitable size is placed under the mud guard and another on top of it at the point where the dent is located. These blocks should be of smooth, hard wood. The clamp is screwed as tight as possible with the fingers as shown in the illustration of Fig. 1. Then the clamp is gently rocked back and forth. The pressure and the motion slightly flattens the dent and the screw of the clamp can again be tightened. The operation is repeated until the dent is completely flattened out.

Fig. 1. You can use a C clamp and two blocks of smooth, hard wood to flatten out mud guard dents

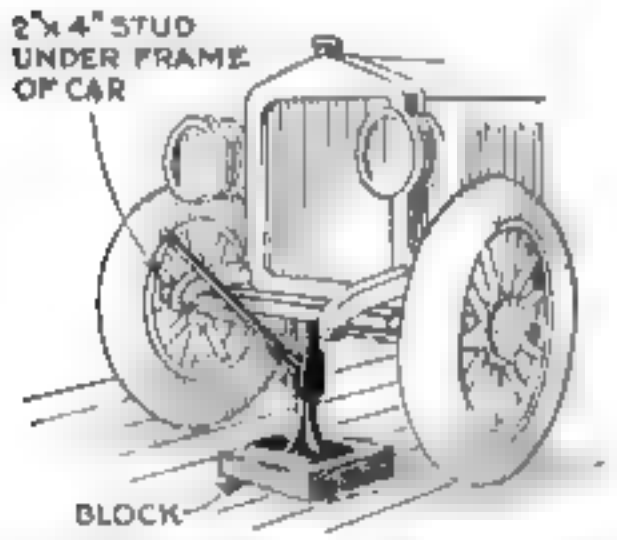


Fig. 2. Here is a simple way to jack up the frame of the car so as to take the weight off both front springs. The splash apron, of course, is removed

Taking Weight Off Springs

THE front end of an automobile may be easily raised to permit the removal of the springs. All you need is the regular jack, a wooden two-by-four, and a block of wood, arranged as in Fig. 2.

Fig. 3. A rear fender guard like this prevents motorists from hooking your bumpers. It can be removed easily and quickly for changing tires

FenderGuardAvoidsHooking

IN FIG. 3 is shown a simple rear fender guard that will keep the other fellow's bumper from catching in yours if he happens to swing in too close. It is made of angle iron with portions cut away at the points indicated to clear the edge of the fender. By removing the rear wing nuts and loosening up the front one the guard can be removed for tire changes.

Ten Dollars for an Idea!

E. E. LINDSAY, of Champaign, Ill., wins this month's $10 prize with his suggestion of an oil filter (Fig. 5). Each month POPULAR SCIENCE MONTHLY awards $10, in addition to regular space rates, for the best idea sent in for motorists. Other contributions published are paid for at the usual rates.

Ingenious Oil Filter

FIG. 5 shows a homemade oil filtering system that can be applied to any automobile to make it modern and up-to-date.

You need one vacuum tank in good working order. A serviceable one can be obtained at a low price from any auto wrecking yard. In addition, you need the outer shell of another vacuum tank to serve as a filter compartment. Of course, this tank could be soldered up from sheet metal in any shape desired. Copper piping is used to connect the tanks as shown in the illustration. If your car is fitted with a vacuum tank to supply gasoline to the carburetor, fit a tee instead of an elbow on the intake manifold pipe. If your car has no vacuum tank, run the air pipe from the vacuum tank which is to pump oil through the filter directly to a coupling fitted into a hole drilled in the intake manifold. As long as the motor is running, oil will automatically be pumped up through the filter and allowed to run back into the crank case. This system will work perfectly on any type of gasoline engine no matter what type of lubricating system is used.

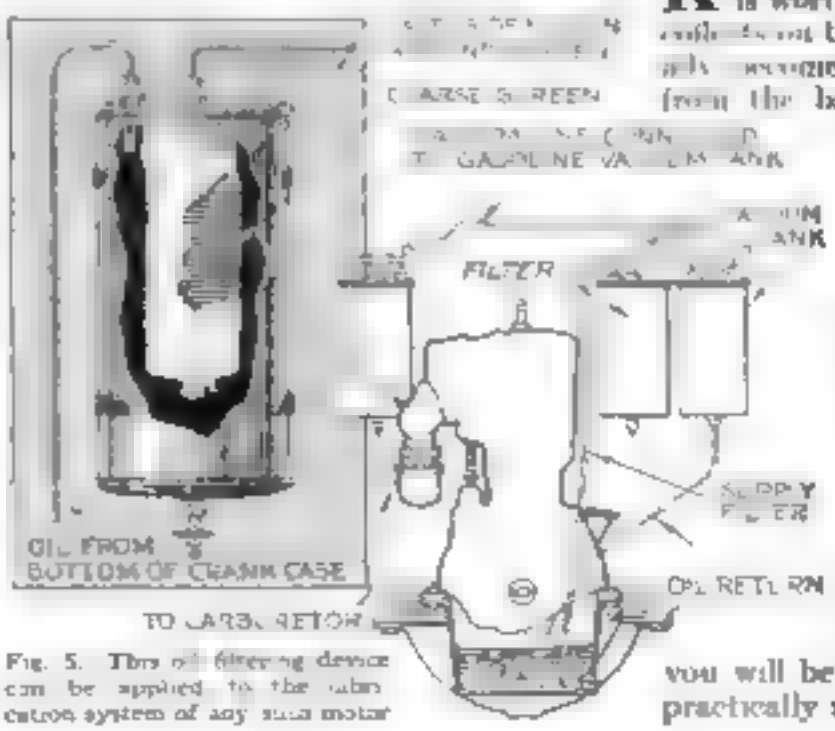


Fig. 5. This oil filtering device can be applied to the lubrication system of any auto motor

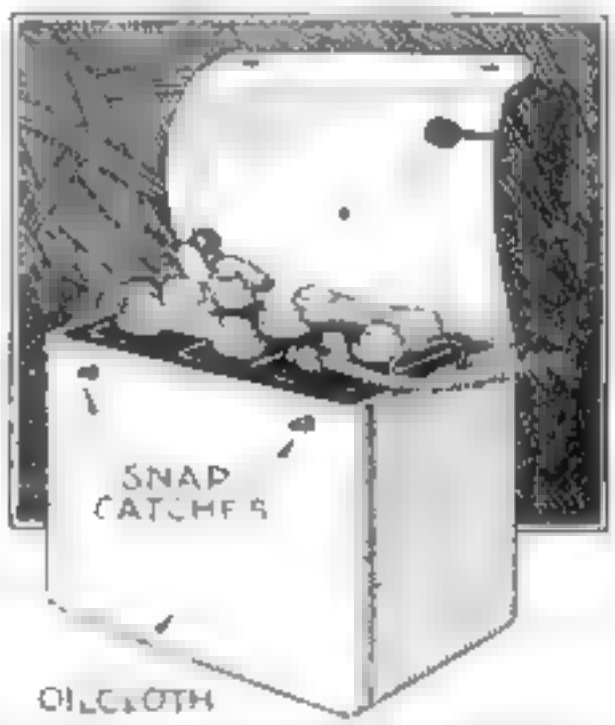


Fig. 4. A cover made of oilcloth will keep the battery clean and stop corrosion and current leakage

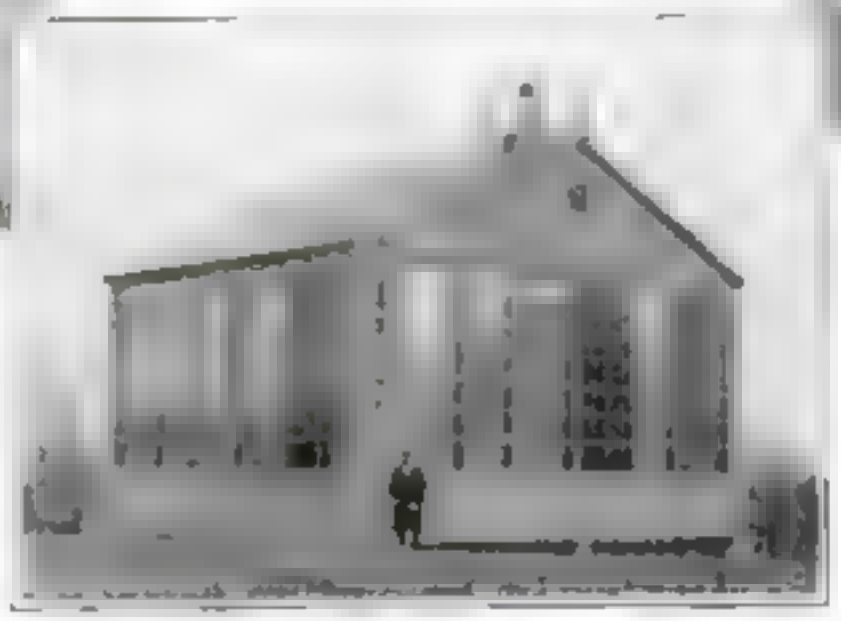
Cover Keeps Battery Clean

KEEPING the starter battery clean is worth while because the dirt that collects on the top of the battery eventually becomes soaked with creeping acid from the battery and greatly increases the corrosion as well as the leakage. A piece of oilcloth as shown in Fig. 4 will serve to keep dirt and water splashed up from the road from collecting on the top of the battery. It can be made to fit snugly by cutting openings for the cables and fitting snaps along one edge to hold it in place. If the top of the battery is wiped off with a rag moistened with household ammonia at intervals, and the cover is kept buttoned, you will be able to keep the battery in practically new condition.

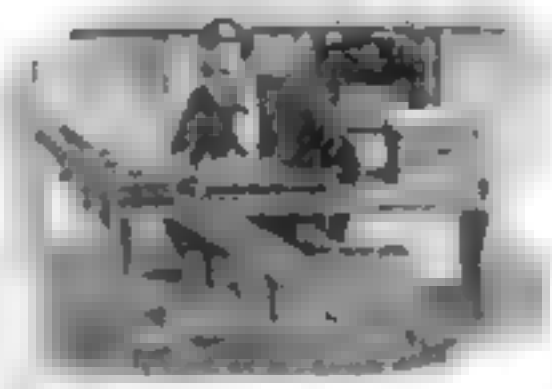
World's *Queerest* House All Windows

Transparent Walls Are Shifted While Ceilings Rise and Fall—All to Find Secrets of Sunlight

Varying the heights of the four quarter-sections of the ceiling of the strange house of glass. Each part may be moved independently of the others to be as low as a kennel roof or as high as the house itself



The experimental glass house held upright by guy wires. On the platform on the roof a photo-electric cell apparatus records the changing degrees of sunlight for comparison with records made inside



The interior illumination recording device mounted on a carriage so that it can easily be moved about in the glass house

SHALL we live, some day, in glass houses? Are present-day dwellings with massive walls and gloomy interiors all wrong? In order to find out, the U. S. Public Health Service has just erected on the outskirts of Washington a dwelling all of glass, whose ceiling moves up and down in sections and whose windows appear and disappear as if by magic. On some days when you enter the structure you will see about you nothing but movable windows, juggled about to block off first one section and then another while experimenters measure the daylight that enters. Sometimes the weird habitation is shaded dark as a cellar, at others as glaringly bright as a motion picture studio. Its four-piece ceiling may scrape your head or slide upward to provide lofty spaciousness.

The purpose of the experimental illumination cabinet is to help discover just how big, what shape, and where the windows in your home should be. It marks the most thorough scientific investigation of the cheapest illuminant in the world—daylight. While laboratories are scientifically improving electric lamps, natural illumination, whose tremendous hourly variation makes it an elusive quantity to work with, has hitherto depended almost entirely on a few windows at places often determined by an architect's whim.

There is no guesswork about the U. S. Public Health Service's tests, however. Within the glass house, a delicate electric recording device known as a Case photo-electric cell registers more accurately than can the human eye the amount of light in any room; while, on the roof, another electric recorder ceaselessly indicates for comparison, the brilliancy of the sunshine outside. As the experts, under the direction of Dr. L. R. Thompson of the Division of Industrial Hygiene and Sanitation, make walls into windows and windows into walls, the machine jots down on a rolling sheet of paper the effects of the changes. Its working is supervised by Dr. J. E. Ives, physicist of the Health Service.

From its charts, the experts expect to learn how to build windows in houses, and whether dwellings need be only partly of glass, or should be transparent structures, all "show windows" held together by pillars and beams. Tests are being made with ordinary panes "health glass," which admits the sun's ultra-violet rays, is next to be tried. The best ceiling height for best lighting, and what colors for walls and ceiling best relieve eyestrain, are two other problems being studied.

Two Pin Points of Light

Replace Single Star and Puzzle the Astronomers

ARE astronomers watching through their telescopes a star that has cracked in two and is flying apart? African and South American dispatches have just confirmed the fact that Nova Pictoris, an apparently single star when it mysteriously blew up in a flash of light in 1925, is for the first time discernible as a very close double star. Now the world's leading astronomers are arguing whether the twin was always there, or has just been born before their eyes—an event of such tremendous importance to astronomy, if true, that they are reluctant to believe it without infallible proof. Still, they concede the possibility.

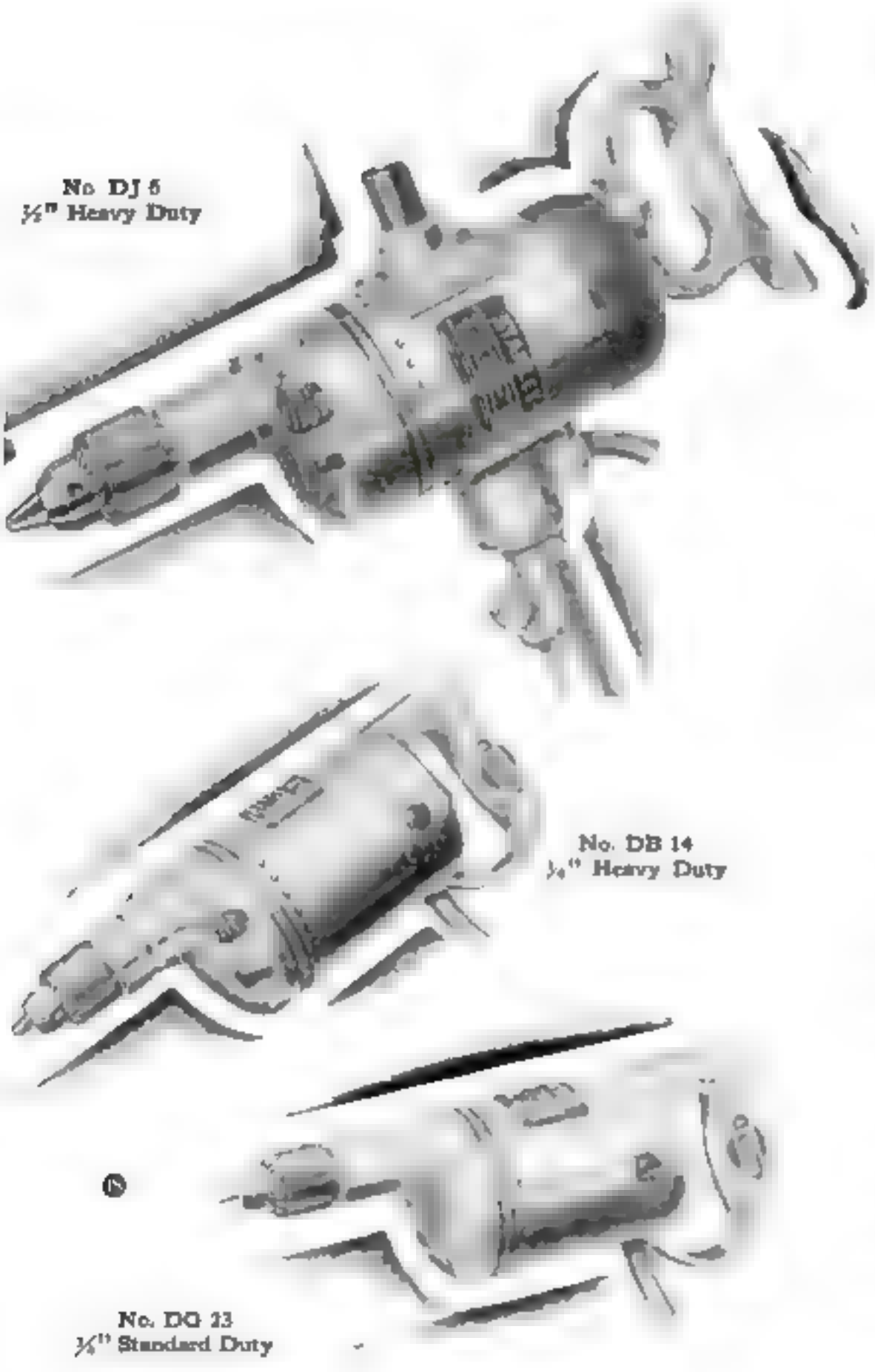
Ordinarily the evolution of a double star requires millions of years. Astronomers were skeptical when Dr. W. S. Finsen, of the Union Observatory at Johannesburg, South Africa, first announced that he had perceived a twin star so close to Pictoris that his telescope could barely distinguish them. But doubt vanished when reports came from two continents that the twin had been spotted, making Pictoris the first known double star among the novas—stars that burst into brilliance and fade.

Did the twin really split off in the 1925 explosion that jolted but did not destroy Pictoris? Prof. Harlow Shapley, director of the Harvard Observatory at Cambridge, Mass., telegraphs POPULAR SCIENCE MONTHLY that he considers this unlikely. "Highly important" to theories of nova behavior, however, he terms the confirmed discovery of the new twin of a star already noted for its curious nebular envelope and its extraordinarily leisurely rise and fall in brilliance, which he calls a "slow movie" of typical nova performance. He wants further confirmation of the doubling, and suspects some possible past encounter of the star with another member of the universe.

"The explosion itself," he explains, "may have been caused by collision with a comet or another star, or by tidal action from a passing star." The possible celestial collision he suggests is unprecedented in astronomical observations.

"To me it seems premature," wires Edwin B. Frost, director of the Yerkes Observatory at Williams Bay, Wis., "to conclude that a collision occurred. Nova Pictoris may always have been a binary." And Prof. F. H. Seares, of the Mount Wilson Observatory at Pasadena, Calif., says the doubling of Nova Pictoris is "not yet clear."

Read what expert users say about the new Stanley Electric Drills



Performance speaks for itself.

Consequently we have asked expert carpenters and mechanics to try out these new Stanley Electric Drills and give us their opinions. Here are a few of the many gratifying comments we received:

"I used it almost continually all day and it didn't heat up at all"

"I never saw a stronger motor. It is almost impossible to stall it."

"The easiest drill to operate that I ever saw."

"The men in our shop always pick the Stanley Drill."

"We have never had anything that would touch it for power and performance."

You too, no matter what kind of work you are doing, will like these new Stanley Electric Drills once you have tried them.

Most dealers will have them and will be glad to let you test their efficiency on either wood or steel. We feel confident that you will render the same verdict as the men whose comments are noted above.

Send the coupon for Catalog Sc59 which contains full information as to size, weights, and capacities.

STANLEY TOOLS

The choice of most carpenters

The Stanley Rule & Level Plant
New Britain, Conn.

Please send me Catalog Sc59, describing the new Stanley Electric Drills.

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This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

SPEED with a Homemade Coaster

An Improved Design for a Safe Swift Toy That Teaches Boys Steering, Braking, and Road Wisdom

By HI SIBLEY

Inexpensive spot lights supplied with current from a second-hand storage battery are used as headlights and the radiator cap is also a standard accessory. A regular steering wheel is used

FEW recreational devices afford children more wholesome pleasure than a well-made wheel coaster. Incidentally, the motor-car type of toy gives them sound preliminary training in steering, braking, and road rules long before they are permitted to take the wheel of the family car.

Although the design illustrated is not self-propelled, it is so light and runs so easily that in level sections it can be pushed with little effort at a brisk speed. If one cared to go to the expense, no doubt a self starting motor and storage battery could be fitted in place of the dummy gas tank, and, with proper gear ratio through chain and sprockets, a fair mileage could be attained on one charge.

Past experience in making several coasters of this type has made it possible to eliminate most of the faults of its predecessors, namely, unnecessary weight, a tendency of the steering cable to become loose, and unreliable brakes.

Lightness is achieved largely through using a ¾-in. red cedar board for the "main frame," and bracing it underneath with a long ¾ by 3 in. truss or rib. The wood axle bars are of white pine, which is light and not likely to split; but they could be of oak, maple or other hardwood. They are grooved to receive the steel axles, which are held snugly in place by several 1-in. No. 13 (⅛-in. diameter) flat-head wood screws and four end blocks and collars, as shown.

Side view of the coaster. To make the brake construction clearer the pedal has been shown as if it were at the left instead of the right side

The tendency of the ordinary coaster to come apart is overcome by using screws and bolts throughout the construction instead of nails.

Build up the hood framework as indicated. Place the seat and determine the proper angle for the steering post by fitting them to the prospective pilot. This is important.

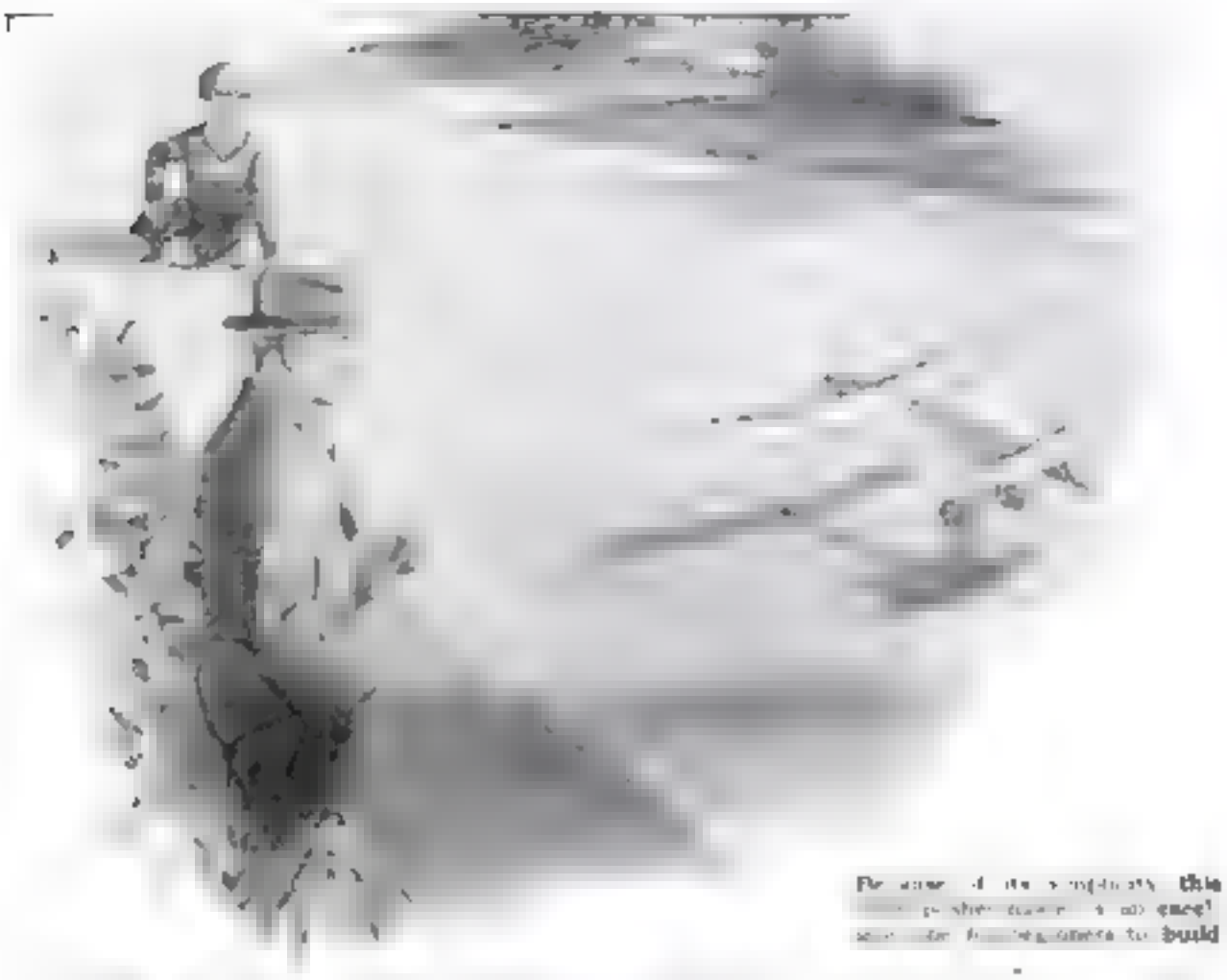
In this case cold-rolled shafting ¾ in. in diameter was used for the steering post, but gas pipe would do as well. By no means use a broomstick or any kind of wood as in a spill it might break off and cause serious injury. A regular automobile steering wheel can be picked up for half a dollar at any wrecking yard. If you have no breast drill, you may have to call on some friendly garage mechanic, blacksmith, or machinist to put the cotter-pin holes through the shaft inside the dash and to pin on the steering wheel, although the latter may be driven on a tapered end to make a tight fit. The front end of the steering post rests in a hole bored in a footblock which is about 2 by 6 by 8 in.

A low center of gravity and a wide tread make for safety when turning curves at high speed

USE white pine for the steering-cable drum if you have to carve it out yourself, but hardwood in case you are able to turn it on a wood lathe. In either case, fasten it in place on the steering post by a pin or a long wood screw; or, if you prefer, drive it into position, provided the hole in the center is a tight fit on the shaft.

The sash cord used for the steering cable in other models always would stretch and become loose, but in this car a flexible woven wire cable was used with signal success. After once being drawn tight and well (Continued on page 93)

A "Rise-*off*-Ground" Model



It Will Fly 1,000 Feet After Taking Off under Its Own Power Like a Real Plane — Designed For the Beginner

By

J. DANNER BUNCH
and AVISON F. KOCH

THE rise-off-ground "pusher" airplane model illustrated is an exceptionally good one for the beginner to construct. The little model reproduces in miniature the flying characteristics of a full size airplane unusually well, it makes pretty take-offs and good landings. It is easy to balance and so strongly constructed that it will stand the hardest shocks of landings and collisions.

The fuselage is made of two white pine longerons ⅛ by ¾ by 24 in., well sandpapered. The center compression strut is of bamboo ⅛ by ⅜ in. and holds the longerons 1¾ in. apart. The strut is located 10¾ in. from the front. The front and rear compression struts, which also are bamboo ⅛ by ⅜ in. are cut to fit and located 6 in. from the front and the rear ends of the longerons respectively.

The compression struts are secured to the longerons by sharpening the ends and gluing them into slits in the longerons. The slits are made by inserting the point of a knife blade into the side grain of the wood. The front and rear of the longerons are cut at an angle so they will fit together well.

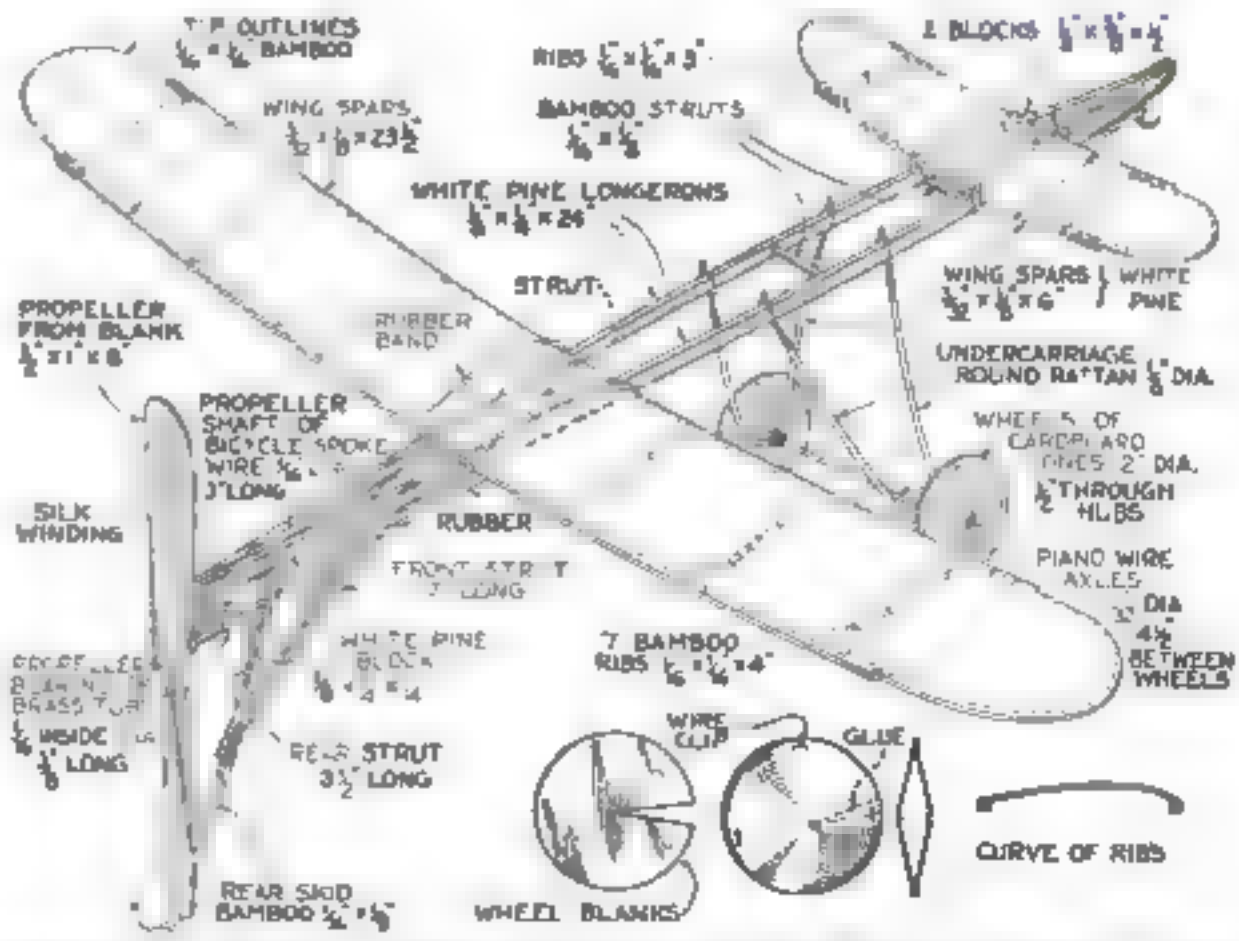
The rubber hook at the front is made of ⅛ in. diameter piano wire. It loops over the end of the fuselage, and the whole front assembly is completed by binding with silk thread and gluing.

For the propeller shaft bearing cut a block of white pine ⅛ by ¼ by ⅛ in. and groove the underside to make a cradle for the bearing. The bearing can be made from a piece of brass tubing ⅛ in. inside diameter and ⅜ in. long. Flare one end so it will not slip forward through the threads. Ready-made bearings can be purchased from airplane model supply houses. Glue the assembly well and bind with silk thread as shown on page 104.

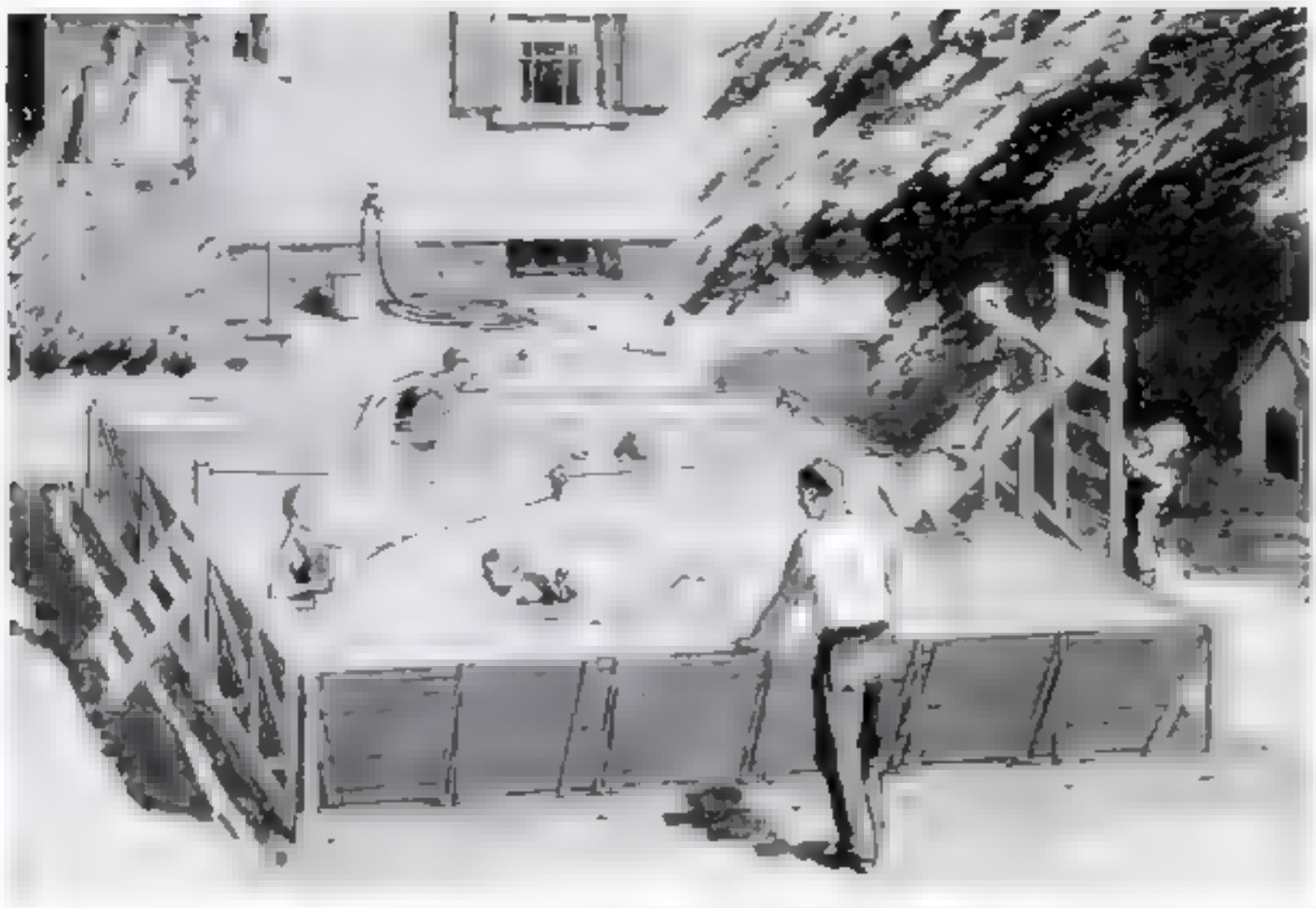
Glue two white pine blocks ⅛ by ¾ by ⅛ in. to the longerons 3 in. from the front end. The front spar of the elevator rests on these blocks so it will have the necessary angle of incidence.

The rear skid is made of bamboo ⅛ by ⅛ in. The front strut is 7 in. long with the bottom turned up so it will slide along the ground under the propeller. The top ⅛ in. is bent parallel to the longerons, where it is later bound in place. The rear strut is 3½ in. long. The lower ⅛ in. is bent parallel to the front strut and bound and glued in place at a point 3¼ in. down the strut. The upper ends of both struts are now split down their lengths to the lower binding, thus making four legs ⅛ by ⅛ in. These legs are bound to the longerons with silk thread and glued. The front legs are placed 3 in. from the rear end of the fuselage, and the rear legs 1 in. from the end. Be sure the fuselage and skid are true and perfectly aligned.

The undercarriage is made of rattan ⅛ in. in diameter. It should hold the axle 4¾ in. from the fuselage. The upper ends of the struts are 2½ in. apart. The front struts are located 9¼ in. from the front end, the rear struts, 12 in. Reinforce the top of the struts down their length ½ in. by binding with silk thread and gluing. Drive a *(Continued on page 104)*



How the "R.O.G." model is assembled. While there is nothing difficult about the construction, the dimensions must be closely adhered to and the drawings followed in every particular of the assembly



Scorching summer days and no safe place for the children to swim? Why not make an inexpensive splash pond like this in your own yard? The water is held in by an old tent fly, tarpaulin, or sail

Back Yard Swimming Pool

J. V. HAZZARD Tells How His Children Use for Their Own Little Old Swimming Hole a Homemade Substitute, Which Is Merely a Collapsible Wooden Framework Lined with Canvas

AFTER a short stay at the seashore, it became almost impossible to keep my two small children out of the water. Swimming in local streams, notably unsafe for competent swimmers, was out of the question for them, and remembering a boyhood proclivity for the old swimming hole—with or without parental approval—I set to work to produce a safe pool at home. The result is illustrated—a back yard splash pond.

Concrete was out of the question, but why not a wooden box lined with canvas? This would do away with the necessity of a bottom, and I had an 18 by 24 ft. tent fly too old for real camping but strong enough for the purpose if backed up with planking.

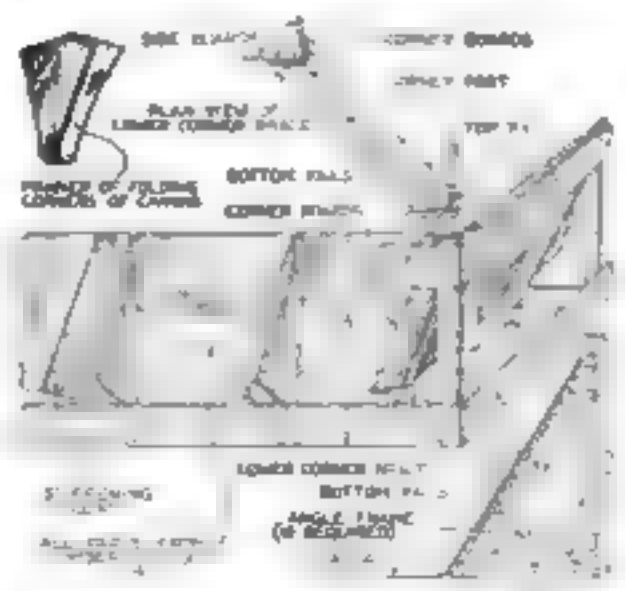
Plans were made for a pool 3 ft. deep, 14 by 21 ft. at the top, and 10 by 18 ft. at the bottom—amply large enough for children up to ten or twelve years. The side panels are ⅝ in. thick dressed tongue and groove pine, 4 in. wide; the angles and braces are of the same stock. Nearly any lumber could be utilized, but the use of the lighter material makes the panels easier to handle and store. Each of the four panels constitute a unit which can be laid flat after the angles are removed.

For a pool of this size eighteen angles are required, four at each end and five along each side. These angles are held in position by flat-headed sheathing nails driven through the panels from the inside; they are also nailed to the base strip running around the bottom. A similar strip about the top, although not essential, materially strengthens the structure.

"Two-by-four" posts supporting a wire with a pulley and a canvas strap prove a useful addition for teaching a child to swim. A side lined with ordinary table oilcloth over strong canvas is an added attraction.

To fill the pool the garden hose is directed over the side; while to empty it a short piece of hose siphons the water to a ditch leading to the truck garden.

Nearly any large canvas may be used, regardless of weight. If it is mildewed or of extremely light weight, say six- or eight-ounce, it should be treated with a solution of paraffin and gasoline. This is made by placing a pail containing a couple gallons of ordinary gasoline—not high test stuff—in a tub of hot water and shaving the paraffin into it. A pound of paraffin to a gallon of gasoline is sufficient, and two or three gallons will waterproof a large canvas. It is applied to a large surface with a brush. Small holes may be patched with circular pieces of canvas stuck on with an ambroid or other type of waterproof glue.



How the angle supports are made and the framework is assembled and braced at the corners

Decorative Metal Working

The Simplest Way to Form Thin Brass and Copper into Artistic Candlesticks and Ash Trays

By Edward Thatcher
Noted Teacher of Art Metal Work

ABOUT the simplest type of decorative metal work is made by cutting out sheet metal with the snips or a cold chisel, forming it with the aid of wooden blocks, and fastening the parts together with rivets. Some very fine work may be done in this simple way. Figure 1, for example, illustrates an easily made copper or brass candlestick consisting of three parts cut out as shown in Fig. 5, page 102

A piece of No. 20 gage soft rolled sheet copper or brass 7½ by 9 in. may be used; the former is always softer and more easily worked. The metal may be purchased in large sheets of about 30 by 60 in., or in strips of various widths. The gage number indicates the thickness the higher the gage, the thinner the metal No. 30 is almost as thin as writing paper, while No. 8 is about ¼ in. thick. For copper or brass lanterns, the gages from Nos. 20 to 24 are generally used, No. 20 being about 1/32 in. thick for hammered bowls and trays, Nos. 16 and 18 are more suitable, No. 16 being about 1/16 in. thick. If no dealer near you handles sheet metals, your local plumber will know where to get them for you

Draw the patterns shown in Fig. 5 on

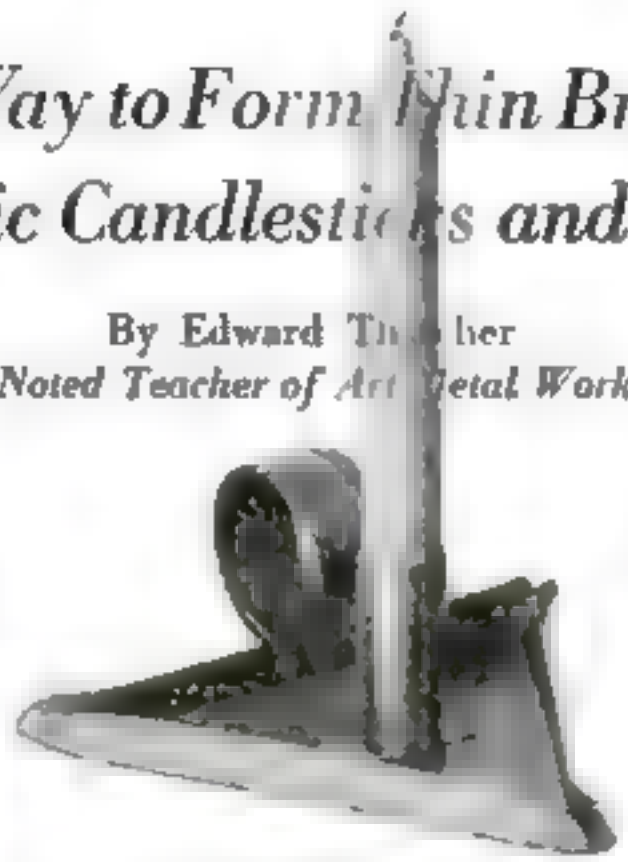


FIG. 1. This copper candlestick was made by Mr Thatcher to demonstrate to the readers of POPULAR SCIENCE MONTHLY that fine work can be done with simple tools and materials

heavy paper, cut them out, and trace around them on the metal with a scriber When the pieces have been cut out, smooth and round over the cut edges with a file and finish them with No. 00 emery cloth. Ordinary chalk rubbed on a file will prevent its becoming clogged with copper

The piece for the tray *A*, Fig. 5, is placed between two triangular blocks of wood about 1 in. thick and the size indicated. The blocks are gripped in the vise as shown in Fig. 2. With the flat face of a wooden mallet, gently hammer along the top of the uppermost edge of the metal and bend it about one third of the way down. Do not hammer the extreme ends at all. Do the same with the other two sides. Now start over again and hammer the first edge down a little more and then the other two. The third time around should finish the tray

BY using a square piece of copper and square forming blocks in the same way, a square tray can be made. Six- or eight-sided trays can be formed similarly and used for ash or card trays (see Fig. 3).

Fig. 2 above. To form the triangular tray the metal is first cut as shown in Fig. 5, page 102 and then held in the vise between two wooden blocks. The edges are turned over by hammering the metal lightly with a wooden mallet, except at the extreme ends, which do not require to be hammered at all

Fig. 3 (at right). The same method may be used to form square hexagonal or octagonal trays. Good design and careful execution are what give these ash or card trays their artistic value

The candle socket (*B*, Fig. 5) is formed by bending it around a piece of ½-in. iron pipe, which is about ⅝ in. in diameter outside, as shown in Fig. 4. The lugs at the base are bent at right angles to the socket with flat-nosed pliers. A rivet hole is drilled through each after the metal has been placed on an anvil and center-punched to mark the location for the hole. A block of wood always should be placed under sheet metal when it is to be drilled

As the handle (*C*, Fig. 5) is of rather thin metal, the long edges should be folded over or "hemmed" to strengthen it and make it smooth to touch. First lightly scribe the lines *D* then bend the piece between two boards as shown in Fig. 6. Go lightly along the strip several times with the mallet until the projecting metal is bent over evenly at a right angle. Remove the piece, place it on an anvil, and hammer down the turned up edge. Treat the other edge similarly This may be done without wrinkling the copper or brass at all

Bend up a section of the strip ⅛ in. from one end to form a lug for riveting

Fig. 4. How the candle socket is formed over a piece of ½-in. iron pipe held in the vise

the handle to the side of the tray. Then form the handle over a pipe or even a suitable piece of wood, round in section, just as you rounded the candle socket (the operation shown in Fig. 4)

For riveting the parts together, use flat-headed copper rivets. The heads are about ¼ in. in diameter, the shanks ⅛ in. in diameter and ⅛ in. long. If you are working in brass, brass escutcheon pins may be used for rivets, provided the shanks are cut to a suitable length.

First mark and drill a hole for the rivet that is to *(Continued on page 102)*

New Colored Ripple Commencement Pens and Pencils

Alluring as Youth Itself

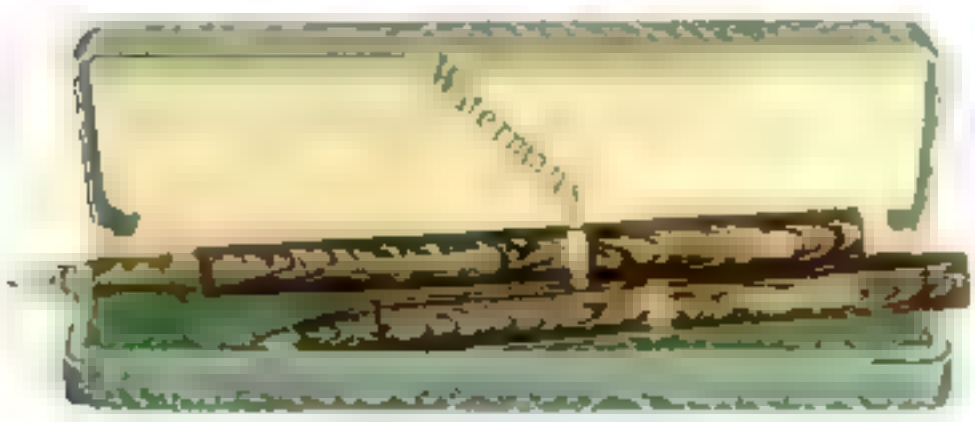
RADIANTLY beautiful in their two-tone ripple colorings, these new Waterman's fountain pens and pencils delight the eyes of thousands of American boys and girls—and appraising parents—especially at Commencement time.

Always the first choice of students the world over. The one faithful writing companion of childhood and old age, Waterman's now ascends the country's graduation platforms in the soft but sensible colorings of summer.

As a Commencement or class promotion gift, Waterman's continues unsurpassed in enduring acceptability. And for the older folks they offer in a wide variety of models the same superior qualities which have satisfied millions for more than forty years.

Colored Ripple Rubber Pens
$4.00 and $5.00

Pencils
$1.50 and $2.00



COMBINATION SETS
Pen and Pencil in Attractive Gift Box
Large Size $7.00 Smaller Size $5.50

HARD RUBBER is superior to all other materials for fountain pen holders. It is seamless, light, resilient and insures perfect writing comfort.

When produced in two-tone colors as illustrated above—Ripple Blugreen, Ripple-Olive and Ripple Rose—it acquires new and unexpected beauties.

Other Waterman's features of these beautiful new pens are the 14-carat gold point, patented spoon-feed, self-filling device that locks, pocket clip-cap, protective lip-guard, and large ink capacity

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Waterman's

ELGIN PARISIENNE WATCH $35

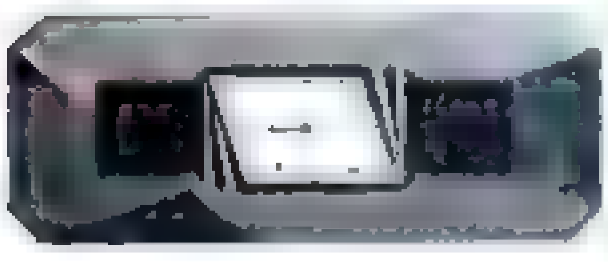
DESIGNED BY THREE FRENCH STYLISTS OF THE PARIS GRAND COUTURE — MADE BY ELGIN

To secure watch-designs reflecting the Paris mode and manner, Elgin consulted three French stylists of the Paris Grand Couture . . . Madame Jenny, Madame Charlotte, creative mind *de la maison* Premet, Madame Agnès, *modiste très moderne*. Under the personal guidance of each of these internationally famous women a special, *moderne*, dainty wrist watch has been created.

Never before such an exquisite watch, such a chic and styleful watch . . . such an utterly reliable and faithful watch for $35!

. . . And a real Elgin! Which means a trustworthy timekeeper.

The case is fashioned with jade, black or ruby enamel. The movement is Elgin through and through . . . with the Elgin guarantee. The hitherto undreamed of low price is only possible because of Elgin efficiency and Elgin's great production . . . A practical, dependable timekeeper of enduring accuracy, as well as a beautiful piece of jewelry. These Elgin Parisienne models are now on display at all jewelers at $35 . . . Elgin National Watch Company, Elgin, U. S. A.



THE PREMET . . . When Premet gave that internationally famous frock *La Garçonne* to the world, smart women of the *beau monde* blessed the name and wore the frock. This chic house has now sponsored this new Elgin model. A genuine Elgin $35

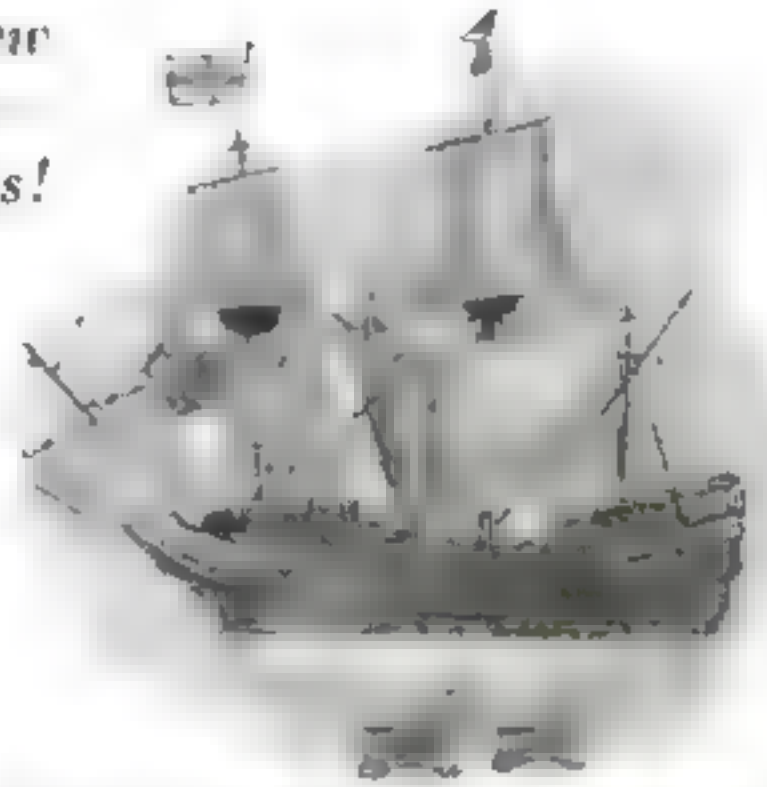
THE MADAME AGNÈS . Throughout the smart, fashionable world the name of Madame Agnès, *la modiste*, stands for one thing, chic, *très moderne!* Now she has given America her conception of a wrist watch . . . enamel ornamented, delicately modeled $35

THE MADAME JENNY . . . In this exquisite wrist watch, the great Paris *couturière* has caught the exact spirit of the modern manner. The case is fashioned with jade, black or ruby enamel. The movement is Elgin which assures watch accuracy the world over . $35

Our *Mayflower* Sets Sail

How to Complete the Rigging of the New POPULAR SCIENCE MONTHLY *Ship Model Aloft with the Canvas and the Flags!*

By E. ARMITAGE MCCANN



This is how your model will look when finished. If you have missed the previous articles, you can still build the *Mayflower* by obtaining and following carefully our Blueprints 83, 84, and 85 (see page 99).

TO FIT the sails to the yards of our model of the *Mayflower* and to rig the yards in position with running gear, are the only tasks remaining. We may then hoist the flags, and our ship will be ready to brave the battle and the breeze—of the feather duster.

Those who have followed closely the instructions in the three previous articles have by now a quaint but shapely hull, colorful without being too gay or shiny looking. On this are the deck furnishings; and the masts and bowsprit are in position, fitted with their standing rigging.

If you missed the previous articles and wish to begin building the model now, you can do so without difficulty by following the complete full size drawings contained in POPULAR SCIENCE MONTHLY Blueprints Nos. 83, 84, and 85 (see page 99).

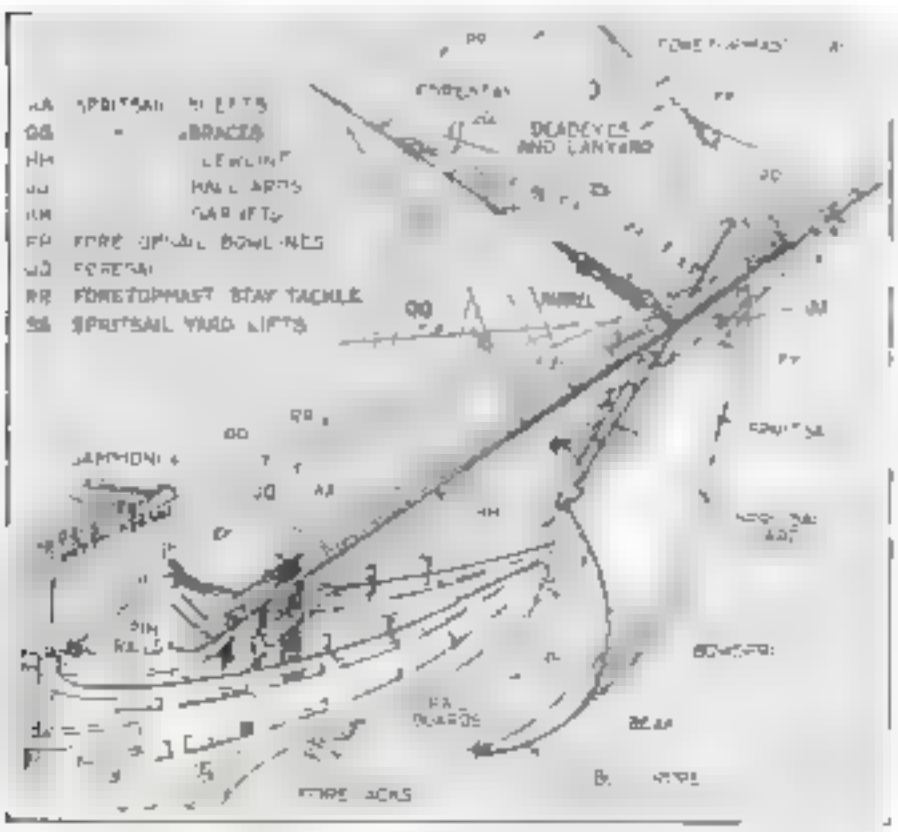
The best material for the sails is a thin linen with a canvassy texture. Patterns for the sails should be taken from Blueprint No. 85 or the sail plan on page 80, June issue. Mark the linen to allow enough for a narrow hem all round, unless the selvage edges can be used for the heads. Before it is cut, the linen should be machine stitched in vertical rows ¾ in. apart. When the real sails were new, their edges (leeches) were straight, but it is better to cut the sails for the model as if they had stretched. The heads should go from yardarm to yardarm without undue stretching, and the clews (lower corners) of the topsails when hanging slack should reach nearly to the yardarms of the yards below.

The lower sails are in two pieces. The lower parts are called bonnets; they could be detached when less sail area was required.

The edges should be hemmed neatly and have some size B cord stitched to them, with loops at the corners. (It will be remembered that we are calling the cords used A, B, C, and D, A being the heaviest (18 thread) and D the lightest, about one quarter as thick.) If desired, smaller loops may be made for the bowlines, martinets, and buntlines. They may be lightly antiqued with strong tea, or other stain, with the color perhaps a bit stronger towards the lower edges.

STITCH the sails with a marline hitch (buttonhole stitch) to hang under the yards. Fasten the bonnets similarly to the upper parts of their sails.

The fore and main yards and their sails should be rigged almost alike. Let us study Blueprint No. 85 and begin with the mainsail: Lash medium size blocks near the middle and small ones farther out for the sheet and clew garnet leads. Make brace pennants of B cord, 2 in. long, with a block in one end and an eye to go over the yard arm in the other; put these on. Strap together a small block, a medium one, and the yardarm. Now make a parrel to hold the yard to the mast. This consists of rows of beads and battens with holes bored in them, through which, and the beads, thin cords are passed as shown on page 109. The cords are hitched to the yard, the trucks and ribs go around the mast, and the other ends go around the yard, around shaft outside the ribs, and hitch to the other ends.



How to rig the spritsail as completely as that on Captain McCann's own model. For clearness some lines appear only on the starboard side

For the halyards to keep the yards up, make a tie block, with a hole athwart for the tie and three holes below for the tackle parts. The tie, of B cord, reeves through this; one end reeves through each cheek, and the ends are hitched to the center of the yard, the length to be such that the block just clears the stay when the yard is up. Fasten the end of the fall (C cord) to the staple in the side of the knight, reeve it through the hook and the knight, and belay the end to the head of the knight itself. Lash blocks under the crosstrees, and through them and the upper yardarm blocks reeve the lifts and bring the ends down to belay to the cleats forward of the guns.

To fit the clews, make a toggle or short stick, strap a large block to this for the sheet, and pass the toggle through the loop at the corner of the sail; above this seize a small block and to it splice or hitch a heavy cord for the tack. Start the clew garnet by hitching the end to the yard, reeve the end through the block at the clew, through the block, under the yard, and bring to the deck.

FOR the martinets for hauling up the sail, make six-fold crow's-feet, stitched to the edge of the sail and leading through small deadeyes, from these the bight of a rope leads through a block, long enough to be above the yard when the sail is stretched. From the masthead descends a pennant with a block in the end. Through this a line from the previous block reeves to the deck. All the lines come to the deck.

The bowline crow's-feet are somewhat different, being made with small bull's-eyes (like deadeyes with one hole) for which beads will serve. They belay to the forward pinrail direct, or first through blocks lashed to the bowsprit.

The buntlines (D cord) start at the lower edge of the sail, reeve through bull's-eyes at the (Continued on page 88)

Steel Ball *Magic* for Mechanics

You Can Put the Hardened Spheres to Many Uses and Save Both Time and Labor if You Follow These Suggestions by HENRY SIMON

Using a bed of steel balls to aid in centering work that must be drilled with great accuracy

IMPROVEMENTS in machines, tools, and instruments crowd upon each other in such rapid succession that we are apt to overlook the possibilities in some of the smaller, yet none the less remarkable, things with which progress is also furnishing us.

Take the steel ball. Nothing could be simpler, yet it is truly one of the marvels of modern engineering. Perhaps no other cheap mass product combines so many remarkable qualities. Even ordinary steel balls vary within only .001 in., while the grade known as "high duty" is true within .0001 in. as to diameter and sphericity. With this wonderfully delicate perfection of form and dimension, there goes an optical finish, as well as a combination of strength and hardness so great that steel balls are everywhere used to test the hardness of almost every other thing made of steel.

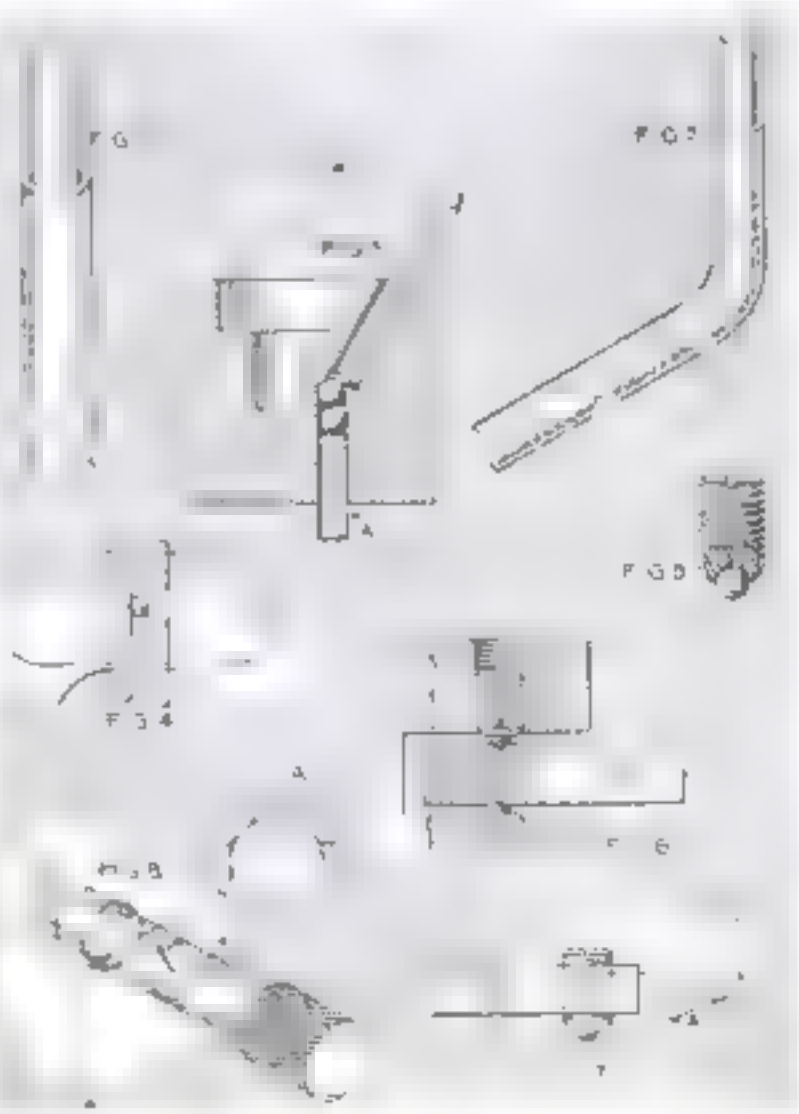
This use of steel balls for hardness tests was an afterthought whereby two of their properties—hardness and roundness only—were utilized. There are other such "afterthought" uses whereby steel balls may be made to serve through any or all of their qualities of precision, hardness, strength, and high finish. In the following, the writer hopes to describe some uses which will be new to the readers of POPULAR SCIENCE MONTHLY.

Let us start with those applications where strength and hardness are indispensable factors. Did you ever "meet up" with a brass tube that was just, say, a quarter or half a thousandth too small? If it is within .001 in. of some regular ball size the chances are you will be able to enlarge it with a grade 8 steel ball—the ordinary or medium grade—in the manner shown in Fig. 1, by forcing the ball through with a rod. Experiment will show what the exact size will have to be to produce the desired enlargement of the hole. Have the rod a loose sliding fit in the tube and put plenty of grease on the ball. Use a screw press where the pressure required is considerable. And don't try to "stretch" this trick. A thousandth or two is about all that can be gained at best, and usually it will be much less.

A SOMEWHAT analogous use of steel balls is shown in Fig. 2. Here a train of them is made to move a plug that would be difficult to get at in any other way. In the same way it is sometimes possible to take the worst of a dent out, provided there is an outlet for the plug and balls after they have passed the dented part. When used in this manner the balls should be loose in the pipe so that they roll freely along, and it should be remembered that a pipe is always reduced or "ovaled" at any bend. "Think before you act" must be the motto here, for a ball wedged in a blind hole is about the most hopeless combination in existence.

A case similar to the last is that shown in Fig. 3. The angular knockout for the hardened flush pin *A* would be of little use but for the balls, as a punch, no matter how shaped, could do no more than barely start the pin. By using balls, even a pin that is a driving fit all the way down can be removed. The knockout hole should be about the same size as the pinhole. Loosely fitting balls must be (Continued on page 106)

MANY timesaving shop ideas are contained in the continuation of the Better Shop Methods Department, to be found on pages 84 and 106 to 108.



How the steel balls are used to enlarge tubing, drive out plugs, test comparative hardness, and make various attachments

They depend on Starrett accuracy

A mail plane drones westward from Chicago. A huge express freight plane lands gracefully at Dallas. An air liner takes off at Boston.

Thousands of miles a day they fly safely and surely with the finest motor equipment the world has ever known — requiring extreme precision of workmanship in manufacture and maintenance.

In the shops of these leading Air Transport operators, where the Whirlwinds, Wasps and other motors are groomed for additional hundreds of hours of flying, you will find Starrett Tools. Aviation mechanics have learned to put their faith in Starrett accuracy.

Whatever your use of tools you need Starrett accuracy and dependability. Ask your tool dealer for Starrett's. Write us for your copy of the new Starrett Catalog No. 24"W" illustrating more than 2500 Starrett Tools.

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World's Greatest Toolmakers
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Use Starrett Tools

1403

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 4.

Lathe Used to Cut Small Gears

IN FIG. 1 is shown a homemade device made by E. H. Redfield, of Springfield, Vt., for cutting clock gears on an engine lathe. The gear is shown in position with a "fly" cutter directly above it. The fixture is held in the tool post.

There is an ordinary index plate, the holes in which were drilled with the aid of a milling machine index head. The indexing is direct, no worm gear or other intermediate gearing is used. The work is supported directly on the index shaft.

Figure 2 shows the indexing fixture in such a position that its make-up may be understood. The whole was made from scrap parts, which accounts for certain

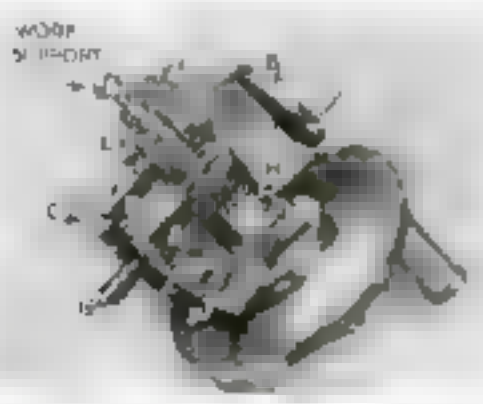


Fig. 2. The parts of this ingenious indexing attachment were made from odds and ends

Fig. 1. Homemade indexing fixture held in a lathe tool post for use in cutting a clock gear

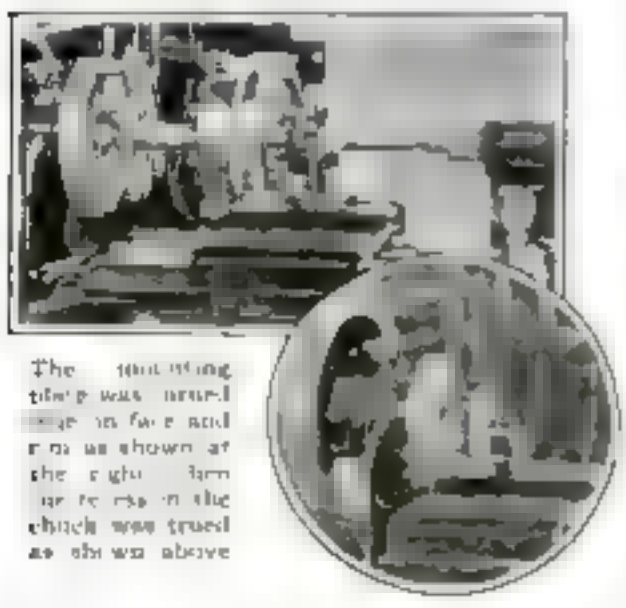
unessential features, particularly the half-worm wheel *H*, the teeth of which are nearly cut off. The dial and work spindle are held in slide *A*, which is manipulated vertically by the handwheel *B*, this being graduated to give .001 in. per line. This provides for cutting the depth of the tooth accurately.

The slide is dovetailed to fit the supporting member *C*, the gib *D* being adjusted by screw *E*. Nut *F* holds in position the nut that the vertical feed screw *G* engages. The worm wheel referred to serves as an end thrust collar *H* for the work spindle. The shank *I* is gripped in the lathe tool post.—O. B. MARSHALL.

Mounting a Small Lathe Chuck

ON A small lathe, especially those sold at moderate prices, the chuck is not always accurately fitted. In one case, where the chuck was mounted on a back plate screwed to the nose of the lathe spindle, this trouble was satisfactorily remedied by the following method.

The chuck was removed from the mounting plate, and the plate screwed in



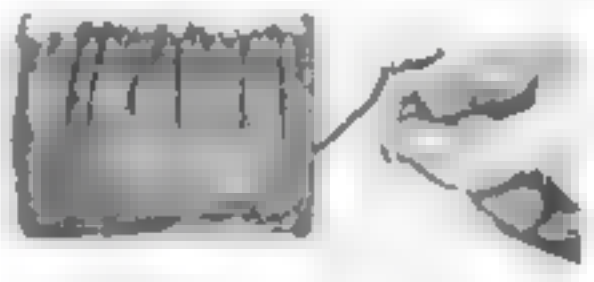
The mounting plate was turned true on face and rim as shown at the right. Then the chuck was trued as shown above

place on the spindle nose and turned true on face and rim. Lack of accuracy here had been responsible for part of the trouble. A stout steel mandrel was carefully turned between centers and the chuck clamped to this by its own jaws. On starting up the lathe, the recess for the back plate proved also to be a little out, as it was turned true. The back plate was now too small for its recess in the back of the chuck. The opening was filled with a narrow strip of hard sheet brass bent into a ring. It would be better, of course, to fit a new back plate after truing up the recess in the chuck, but a new back plate is not always easy to obtain.—H. G.

To set a steady rest when the piece to be turned is a shaft too long to be accommodated between the centers, remove the tailstock, chuck a piece of scrap, and turn it down to the size of the place on the shaft where the steady rest is to be used. Set the steady rest to the piece while still in the chuck. After setting, open the top; without moving the jaws, shift the steady rest and clamp it to the lathe bed at the proper place.—SHERWOOD J. GEE.

How to Prevent Valve-Stem Packing from Unwinding

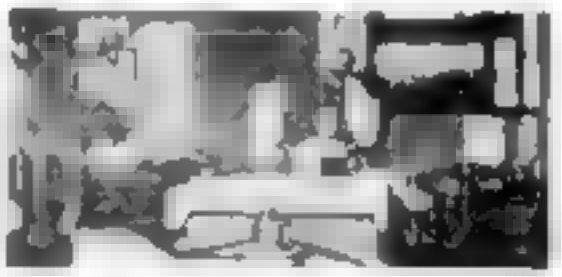
IF THERE is an aggravating thing around any plant it is the spool of small valve-stem packing, which is always getting unwound. Cut off one leg of a ½-in. cotter key about 2 in. long and sharpen the other leg. Slip the free end of the packing through the eye. After taking off the amount required, pushing the cotter back as you do so, stick the point firmly into the coil and cramp the end beyond the eye so that it will not slip. The packing will then stay wound.—F. B.



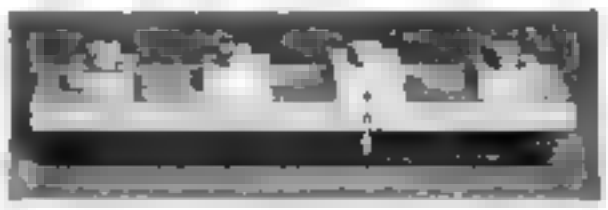
A cotter key having one leg removed and the other sharpened is slipped over the packing

Fixture Holds Washers While Being Ground

THE fixture illustrated was designed for grinding to thickness a number of thin washers, shims, and similar parts. It is difficult to hold small, thin pieces on the magnetic chuck, but this fixture will take four pieces at one setting so they can be ground as thin as .010 in. by feeding carefully. It is made of machinery steel and ground all over. Section *A* is made



The fixture in place on a magnetic chuck with four pieces clamped on for grinding



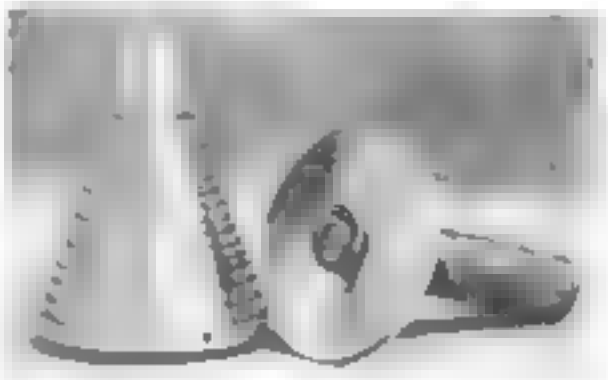
To make it easy to measure the work, the dimension marked "A" is exactly .250 in.

exactly .230 in. thick so that the work can be "miked" in position.

The pieces are clamped so that two thirds of the surface is ground first. They are then turned around and finished. Any slight variation due to the double grinding can be easily removed by lapping.

Set of Plug Gages Made from Old Slitting Saws

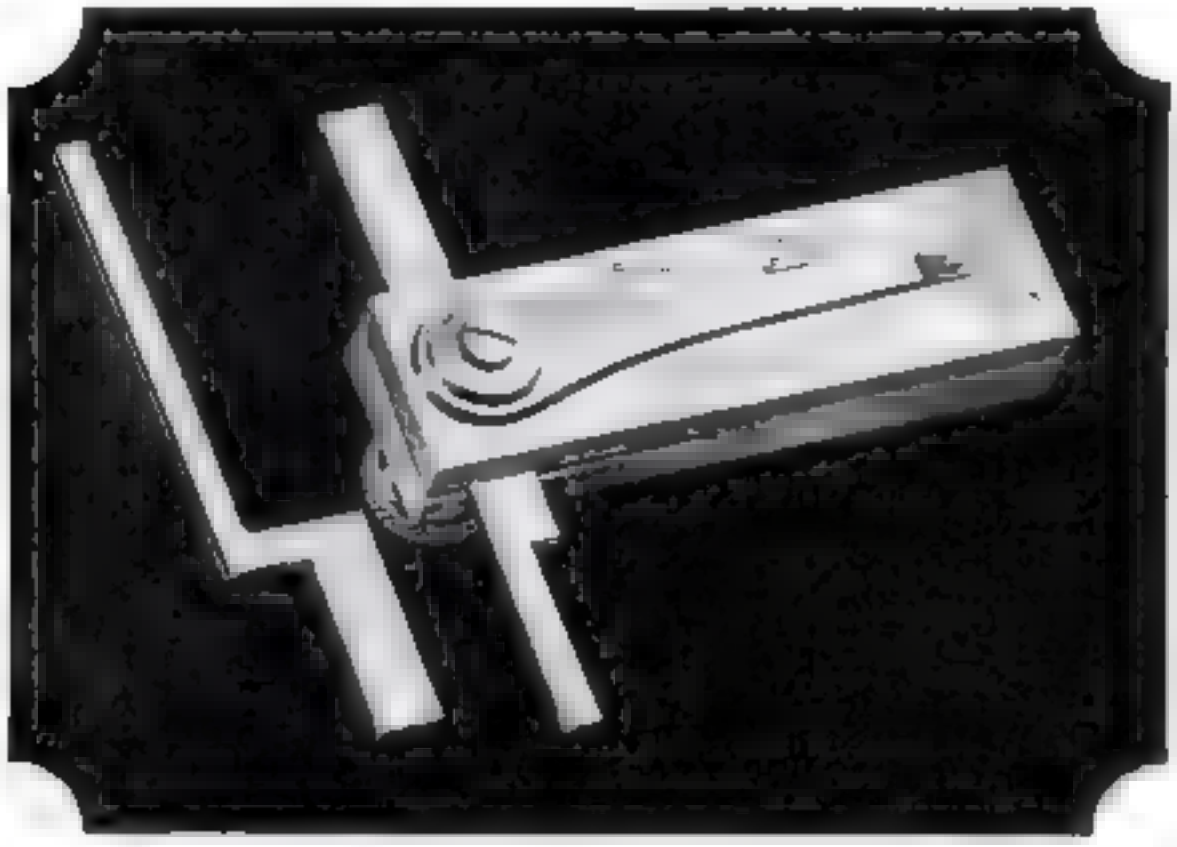
THE plug gages illustrated were made from worn-out slitting saws. After the sizes nearest to the desired diameters had been selected, the saws were rough-



A useful set of plug gages with a knurled handle for testing boring and grinding jobs

ground to plus .010 in. cylindrically and then finish-ground and lapped. They were also ground on the side just enough to remove their concavity.

These gages are very convenient and economical, and they take the place of expensive gages for boring or grinding jobs in the tool room; at least, they allow the better gages to be preserved for highly precise work. The set consists of sixteen sizes from 1½ to 3 in. inclusive. The average thickness is about ⅛ in. A suitable knurled handle completes the outfit.—H. J. CHAMBERLAND.



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* MICROMETER CALIPER
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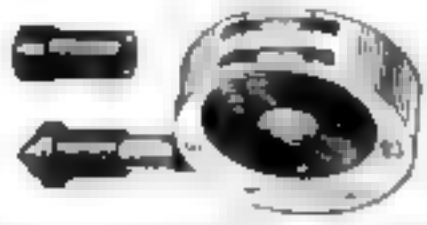
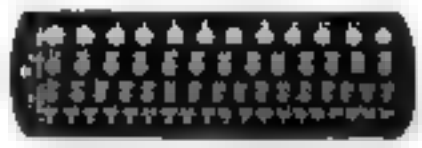
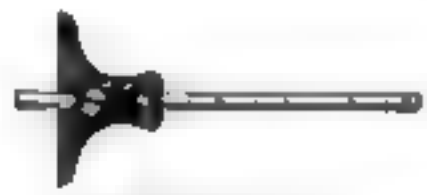


* VEST POCKET SPEED INDICATOR
No. 746

* DIAL TEST INDICATOR
No. 711

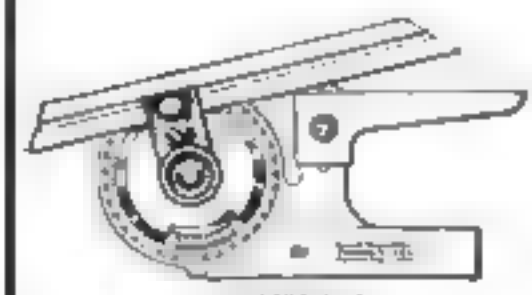


* TWIST DRILL AND STEEL WIRE GAUGE
No. 705



* RULE DEPTH GAUGE
No. 615

* AUTOMATIC CENTER PUNCH
No. 771



* UNIVERSAL BEVEL PROTRACTOR
No. 496

*A *description of this tool appears in Catalog No. 30*

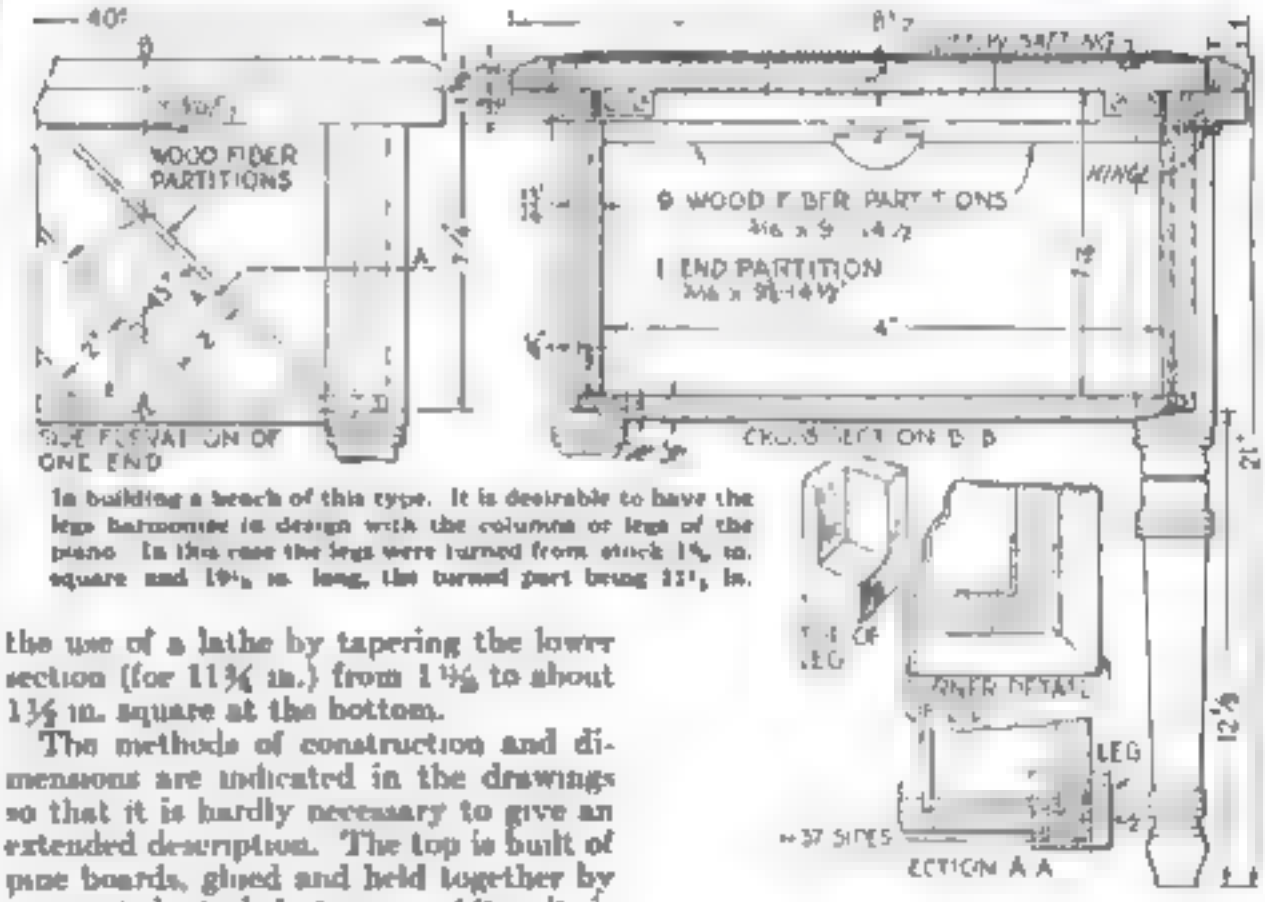
BS WORLD'S STANDARD OF ACCURACY

Novel Piano Bench Contains Music Filing Compartment

By D. A. Price

THIS piano bench has a novel and useful feature in its roomy compartment for filing music. It was made to take care of a larger quantity of music in a more efficient manner than the usual bench. The compartment under the lid was made wider and deeper so that sheet music up to 10¼ by 13¼ in. (the largest size) can be easily filed between the slanting wallboard partitions. These partitions also serve to separate and classify the music.

The bench may be made of wood to match the piano. It might be considered advisable to alter the design of the turned legs to harmonize with the columns or legs of the piano for which it is being constructed. The legs may be made without



In building a bench of this type, it is desirable to have the legs harmonize in design with the columns or legs of the piano. In this case the legs were turned from stock 1⅝ in. square and 19½ in. long, the turned part being 11½ in.

the use of a lathe by tapering the lower section (for 11¾ in.) from 1⅝ to about 1¾ in. square at the bottom.

The methods of construction and dimensions are indicated in the drawings so that it is hardly necessary to give an extended description. The top is built of pine boards, glued and held together by corrugated steel fasteners. After it is dry it should be trimmed to the exact size. Then the mitered lower rails are fitted, glued and screwed to it. The seat padding of cotton batting should be applied to the top with a light coat of glue and worked down thin along the edges. Then the imitation leather covering is put on and tacked on the sides. Last of all, the oak molding strip around the edge should be screwed in place.

The sides, ends and bottom are assembled as a unit in the form of a box. After being turned, the legs are cut out as shown in the detail marked "top of leg" and the "box" screwed into them.

The partitions, of course, could very well be of thin plywood or ¼ in. thick wallboard.

Bedpost Bracket for Clock

Alarm clock bracket attached to bedpost

A FIXTURE for holding an alarm clock may be made and attached directly to any bed with round or square posts by the method illustrated.

The bracket consists of two pieces of ⅛-in. washer stock 1¼ in. wide. Each piece is bent to fit the bedpost after a strip of cardboard or rubber has been placed around the post to prevent scratching. The other piece is bent in two and then shaped to fit around the clock case. The parts are fastened together and clamped to the bedpost with two short stove bolts. The fixture is enameled to match the bed.—Hector J. Chamberland.

To TRY to build furniture with unseasoned lumber will discourage anyone.

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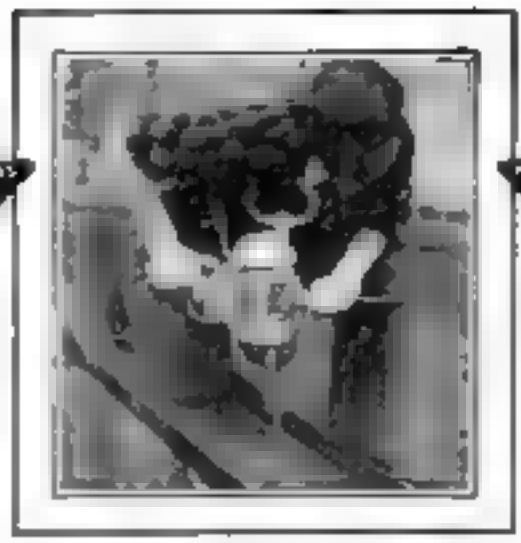
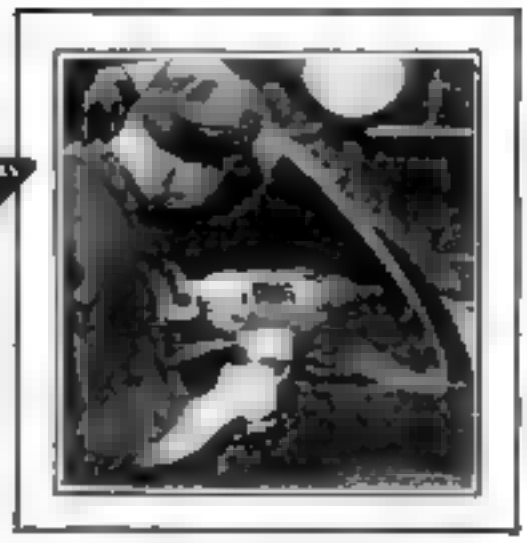


On industrial production work.



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This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Modern Electric House Wiring

What the Home Owner and Handy Man Should Know about the Use of Armored Cable

By GEORGE A. WILLOUGHBY, E. E.

"GEORGE, I need some pointers on house wiring," said Clyde, one of my neighbors, when we met one day near our homes. "I have a permit from the inspection department at the City Hall to do some of my own wiring, but their inspector is going to look it over when I get finished, and I want to be sure I'm right before I go ahead. They asked me some questions and I answered most of them, but I am not quite sure if I'm right on the loop system and identified-wiring idea. Will you tell me the important points about it so I will be sure that I know what I'm doing?"

"I'll be glad to," I replied. "Let's walk over to that new house near the corner. I took a look at the job this morning and, while it could be neater, we can talk about the wiring better if we can have an example before us."

We went to the house, which was still in the process of construction, but before we looked at the electrical installation, I sketched on an old envelope two outlets *A* and *B* and the wiring as in the accompanying diagram (Fig. 1).

"Let us suppose," I began, "that we have an outlet box *A* to which two wires have been led to provide for connecting a bracket, a ceiling light, or a receptacle, and that we are going to install another outlet *B* a short distance away and lead wires to it. Instead of tapping onto the wires leading to *A* as they did in the old tap system, we lead two wires from the outlet box *A* to the outlet box *B*. In this way the connections between the two wire ends at *A* and those leading to *B* are within the box at *A* and are inclosed in metal when the fixture is in place. If trouble arises in an installation it is usually at the joints. In an installation of this kind all the joints are protected and they are accessible. This method of looping from outlet to outlet is used throughout."

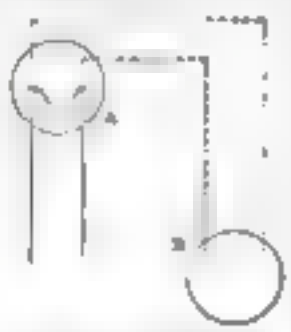


Fig. 1. In BX wiring all connections are in outlet boxes

"Doesn't that take a lot more wire than the method where you tap into the wires?" asked Clyde.

"YES, it does take more material," I replied, "but the installation is so much safer and more satisfactory that it is well worth the slight additional initial cost."

I explained that wires running from outlet *A* to outlet *B* may be two single rubber-covered wires or a two-wire armored cable, usually called, for short, BX. There was an example of both methods at a ceiling outlet near the rear door (Fig. 2), to which I directed Clyde's attention. The BX was used to lead through tile construction to an outlet over the rear door, because tile requires either BX or conduit. Knob-and-tube wiring however, led from the ceiling outlet to the frame part of the house, where knob-and-tube wiring is satisfactory although much less used than it once was.

Fig. 2. Knob-and-tube wiring and armored cable or BX connected within a ceiling box

"Well, I think I see what the loop system is," Clyde remarked. "Now, what identifies the wires?"

"THERE'S a big advantage," I said, "in having the two sides of a circuit marked or identified throughout the circuit. In most modern systems of distribution one side of the line is grounded and the other is carefully insulated from the ground. If you are standing on a damp basement floor or on anything connected to the ground and touch a bare spot on, or a connection to, a grounded wire, there is no danger of getting a shock, but if you touch the other side of the line, look out! Where the two sides of the circuit are not marked, the switches may be in the grounded side instead of the live side and even if you have turned off the switch, you may get a shock when you try to do any repair work or perhaps if you touch a brass socket or other exposed metal.

"In the modern installations we use a white wire to designate the grounded or dead side of the line and the black wire to designate the live side. The switches are connected in the black side, while the white wire is led to the fixtures and connected to the white terminals so that danger is reduced to a minimum. In fact, there is practically no chance of accident if this system is followed carefully through the installation."

Applied WOOD TURNING *for* Beginners

HOW to use your lathe in making a graceful table—Fourth in a series of instructive articles by HERMAN HJORTH

Fig. 1. Using a sandpaper-covered cylinder to shape the legs to fit the turned column

THE stand or small table illustrated in Fig. 2 is an example of what the woodworker can accomplish in the line of furniture making when he has an elementary knowledge of wood turning. From the wood turner's point of view, this project is very simple, as there is only one turned piece. The turning of this piece, moreover, does not involve any particular difficulties. The method of procedure is clearly shown in Fig. 3.

A cardboard pattern should be made for the three legs according to the method of laying out shown in Fig. 4. In placing the pattern on the wood, see that the grain runs the long way, otherwise the legs are likely to snap at their narrowest point. They may be fastened to the turned column either with a mortise and tenon joint or with dowels. The latter method is the easier and, indeed, gives a stronger joint than a poorly made mortise and tenon.

First cut the legs with a turning saw or on a band saw, square the ends, and round the outer edges with spokeshave, scraper, and sandpaper. The part of the legs that fits the column must be curved. This can be done easily by turning a cylinder a little less in diameter than the column—in this case about 1¼ in. Glue a piece of No. 1½ or 2 sandpaper to it. When dry, put the cylinder in the lathe and hold the end of the legs against it until a curve of the proper shape has been formed (Fig. 1)

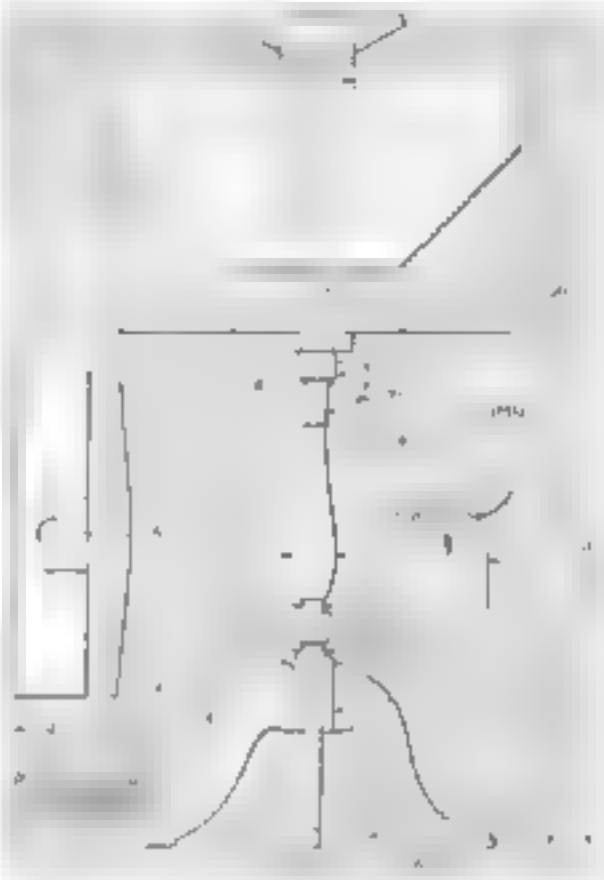


Fig. 2. Elevation and partial top view of the table; details of leg joint and top brace

Locate the centers for the dowels as follows: Wrap a (Continued on page 91)

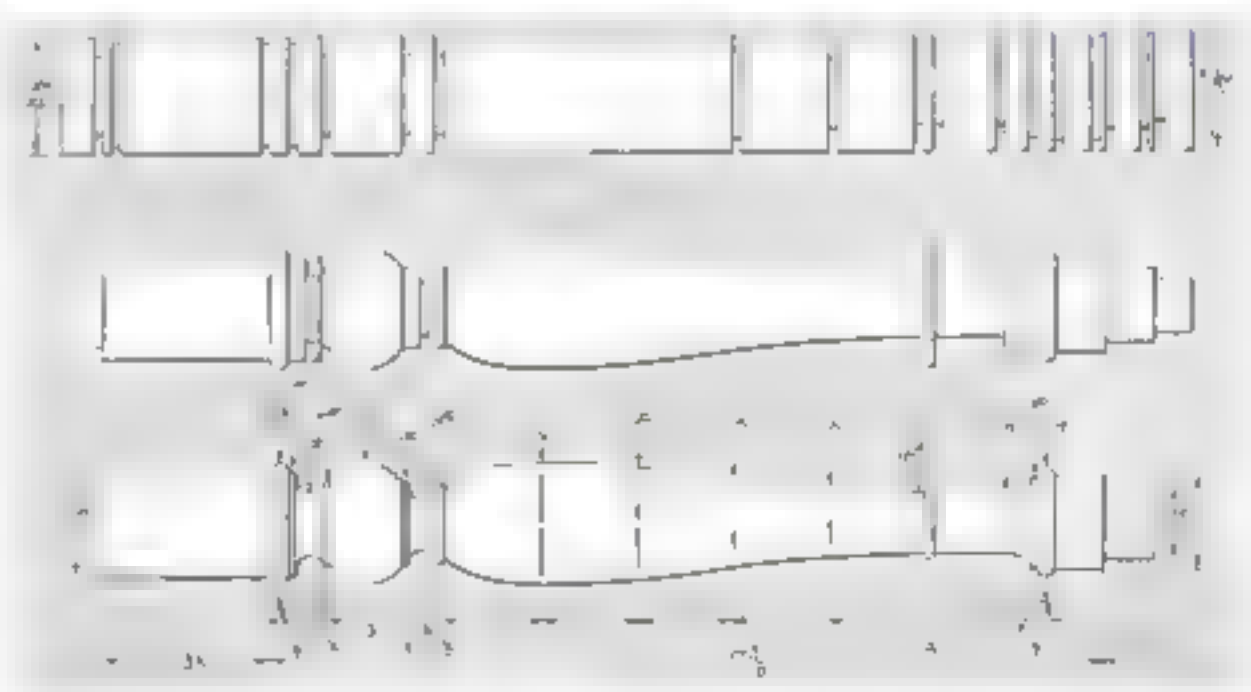


Fig. 3. Three steps in turning the table column. Grooves are first turned to the correct depths, as described in the May article, these guide the finishing cuts, which are made as told in the June article

Wood Turning

(Continued from page 90)

Fig. 4. One of the legs with dowels inserted, all ready to be glued to the turned column

piece of paper around the column and cut it so that the ends just meet. Fold it into three equal parts and lay off these divisions on the column. Place each of these marks level with the top of the tool rest and draw horizontal lines on the column.

Mark the corresponding center lines on the legs with a marking gage and lay out the points for the dowels. Set the marking gage to 1 in. and, holding the block of the gage against the lower end of the column and against the corresponding edge of the legs, mark lines crossing the six center lines already marked. Set the gage to ¾ in. and from the same edges mark another set of lines crossing the center lines. Bore for dowels at these twelve points (Fig. 4) and fit each leg to the column.

Glue one leg at a time as shown in Fig. 5, using three hand screws. One of these is clamped (Continued on page 107)

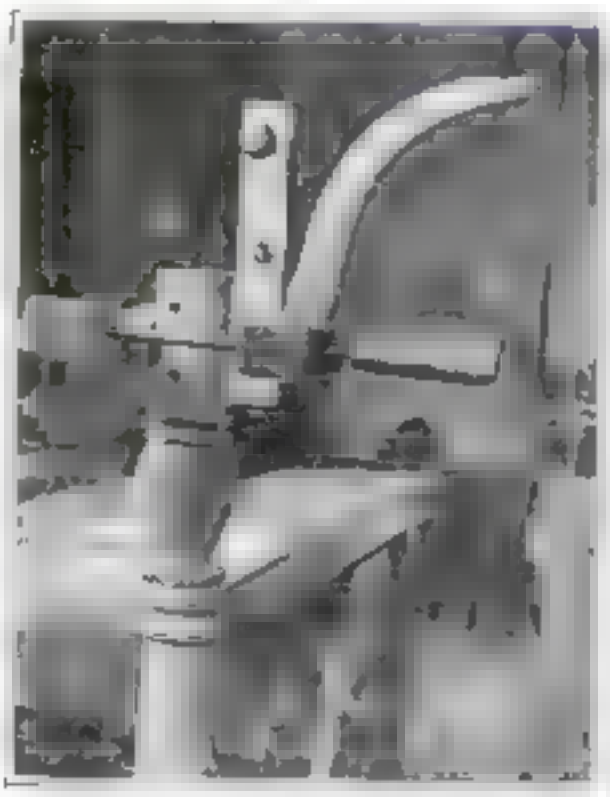
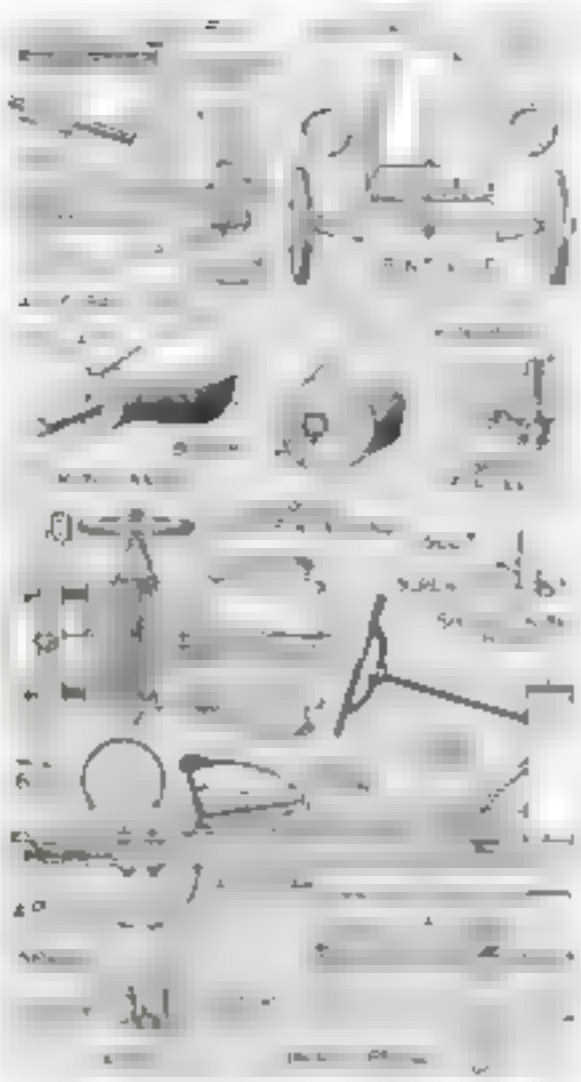


Fig. 5. One leg at a time is glued to the column and held firmly with three hand screws

Speed with a Homemade Coaster

(Continued from page 77)



How front and rear axles, braking device, imitation gas tank, and other parts are made

fastened it remained secure As the cable is wound on the drum at right angles, it has no tendency to climb or slip down. A pulley 1¼ in. in diameter is screwed to the floor board at the correct angle to take the cable without being cramped. The cable is further guided by holes bored in the floor board and in the short piece of wood underneath.

The type of equalizing brake shown will lock the wheels at almost any speed, and as the coaster is light, there is small hazard in "cutting her wide open" on hills. If the brakes are well made, they are not likely to fail in any emergency.

It is important to fit a section of split hose over the sharp edge of the sheet-iron seat back, so that there will be no danger of getting cut in a crash. Brass wire is used to lace it to the seat back through holes punched with a nail.

Wheels, of course, are something that must be bought, and represent most of the expense, unless you have an old set on hand. It will be well to get the best you can buy, the disk type being preferable. On the coaster illustrated the wheels are 11 in. in diameter, with caged roller bearings, and give splendid service. Some boys maintain they can get greater speed out of the old style wire-spoke wheels with steel tires, but they make an unearthly racket, and have not the braking efficiency of rubber-tired wheels.

A pair of spot lights add greatly to the appearance and do not cost a great deal, nor does a tail or a dash light, but the "juice" to light them is something else again. A secondhand 6-volt storage battery will serve the purpose. The battery can be installed in front of the dash, below the steering post.

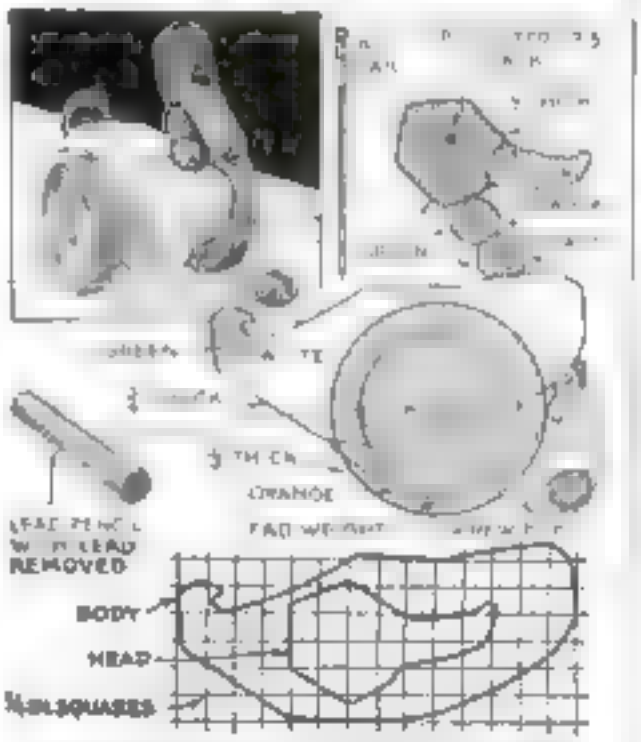
Now that your coaster is completed in a workmanlike manner, take the time to paint it well. The one illustrated is very effective with orange wheels, dark green running gear and radiator band, and light lettuce-green body. The numeral is black, and on the other side there are four exhaust ports painted black. The inside of the seat back and the seat bottom are bright vermilion. The entire coaster was given two coats, followed, when dry, by a coat of spar varnish.

Note that the gas tank is not only for appearance; it is to provide any accommodating "pusher" with something to push against, thus protecting the back of the seat.

While there is considerable work involved in making this coaster, it is well worth the time consumed and the trifling expense for lumber, wheels and parts, and, from the standpoint of healthful recreation and real fun, it will be a long time before you will find another investment that pays such handsome dividends.

This Funny Little Toy Duck Waddles on Its Wheels

By F. Clarke Hughes



If the wheels are placed slightly off center, the duck will waddle as it is drawn along

THE body of this amusing toy duck is cut from soft pine ⅝ in. thick, and the head and wheels are shaped from ⅜ in. thick wood of the same kind. The head is drilled as shown to receive an eightpenny nail, which passes through two large glass or wooden beads and enters the body

To make a bearing for the wire axle, remove the lead from a piece of common round lead pencil 1¾ in. long. Bore a hole through the body of the duck and glue the pencil shell in it. The wheels, which are 2 in. in diameter, are best if set slightly off center. They turn with the axle. As a balance weight to hold the duck upright, a piece of lead must be attached to the lower edge of the body

How to Fill and Hide Wall Board Joints

By F. N. Vanderwalker

A SURPRISINGLY large area of fiber wall board and plaster board is nailed in place each year by amateur mechanics, not alone in summer cottages and in temporary structures, but also in houses, new and old. The manufacturers furnish such complete and clear instructions that there is little difficulty in applying wall board, but when it is in place, the question arises as to how it is to be decorated. There is a choice between filling the joints to conceal them or covering them with wood strips or cloth braid.

When wood strips or braid are used, the placing of the wall board panels as to size and proportion must be carefully planned in advance. In the majority of amateur jobs, however, wooden strips are not used and, unfortunately, too few attempts are made to fill the joints perfectly.

When being filled, the joints are reinforced with open-mesh canvas or soft wire cloth

In almost every case the joints can be concealed permanently if careful work is done. The first step is to have a sufficient number of studs placed in the wall, and they must be straight. Cross bridges are necessary between studs at all joints and where electric fixtures, picture molding, and baseboard are to come. Any irregularities such as a twisted or bent stud will throw one side of a joint out more than the other and make one think one piece of the wall board is thicker than the other. Do not butt the sheets too closely together; allow at least $\frac{1}{8}$ in. between edges to hold the filling putty.

The first operation in finishing the joints is to brush (Continued on page [illegible])

Combination Chest and Desk

How to Build a Space-Saving Piece of Furniture That Is Early American in Style

By Charles A. King

The chest with desk compartment open

AN UNUSUALLY interesting piece of furniture, especially for a small apartment, is the combination chest of drawers and desk illustrated. What appears to be the top drawer is a well appointed desk when pulled out.

The simple construction brings the project easily within the range of the average amateur cabinetmaker. It may be made of birch, maple, oak or mahogany.

Make the ends *a* of ¾-in. plywood. Glue and brad in place at both the back and front of *a* the ⅞ by ⅞ in. pieces *b*, which are cut to lengths equaling the height of the drawers. Leave ⅛-in. spaces between pieces *b* to receive drawer partitions *c* and drawer ledges *d* as indicated. Joint (plane) the front edge of each sidepiece and glue front facings *e* in place. The facings should be ⅜ by 1¼ by 38½ in. and extend to the floor. Two 2½-in. square blocks or false legs *z* should be fitted to support the back of the case and receive the rear end of the base.

Cut drawer partitions *c*, ½ by 2-¼ by 35¼ in., to fit exactly inside of ends *a*. Place these together and cut all shoulders to fit around facings *e* at once to insure accuracy. Assemble the case, fitting a back *f* of ¼-in. sheathing or plywood. Be sure the case is square. Make top *g* of solid wood, work a thumb molding on the edge, nail it in place, and miter a cavetto (stock cove molding) under it.

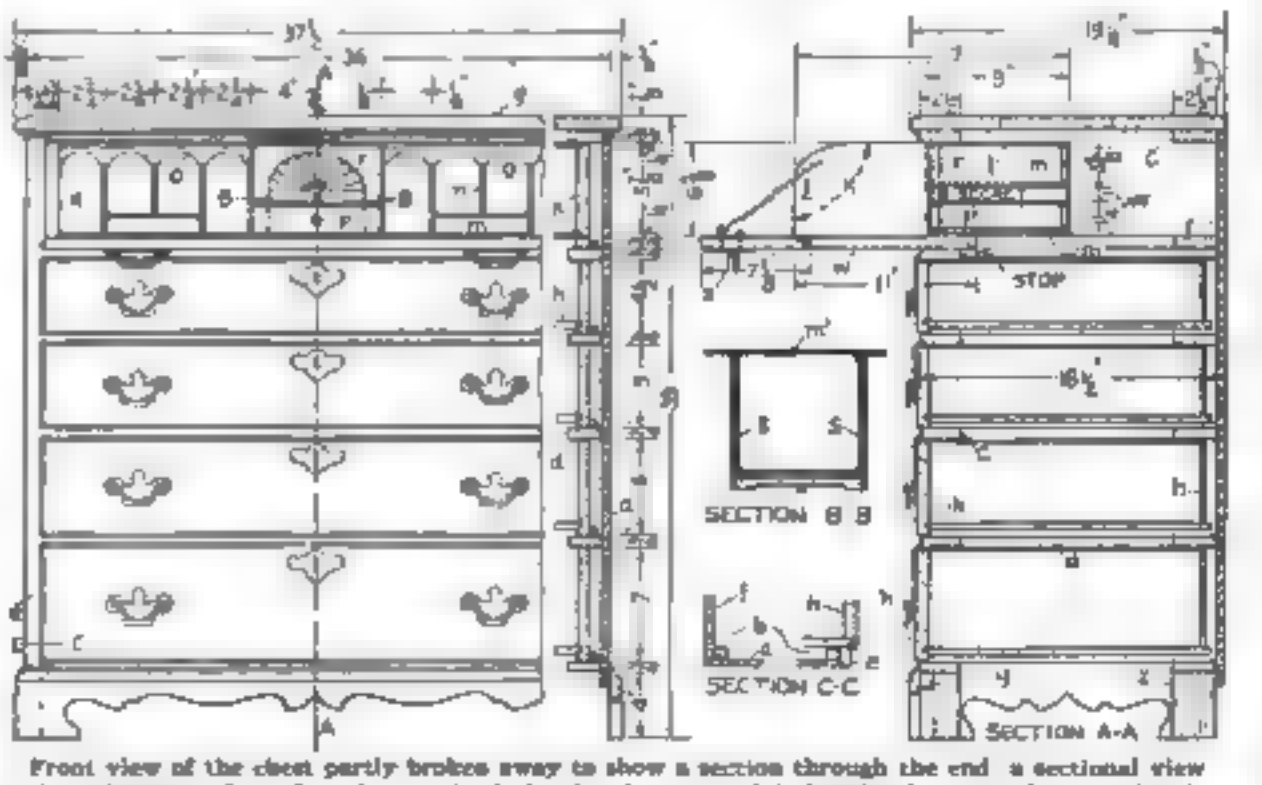
Make the drawer fronts, sides, bottoms and backs as indicated at *h*, allowing ⅛ in. less in length of front to aid in fitting. Make the desk drawer sides *k* ½ by 6⅛ by 17 in. fit the pigeonhole top *l* and the bottom *m*, ¼ by 9 by 32½ in., by means of rabbets into *k*; fit the partitions *n* and the shelves of ¼-in. wood between *l* and *m* and fasten all with brads. Make the arch spandrels *o* ¼ in. thick, each of one piece, and fit them with their faces flush with fronts of *l m a*. Fasten the ¼-in. back *m*¹ in place.

Make lids *w* and *x*; fit and fasten them to *k* as shown. The front of each of the middle drawers *p* and *r* may be made by fitting the sides in the front by means of a rabbet and cutting the back between the sides, which should be ⅛ in. thick, the bottom is brazed to their bottom edges. The ½-in. sides *s* of the secret compartment support the drawer *r*.

Make the ⅝ in. thick base, mold the top edge, miter it, draw the design, and have the profile cut by a band saw if possible. Sandpaper the piece thoroughly and fasten it in place with glue, brads and glue blocks *y*.

Fit broad flap hinges to join *w* and *x*. Fasten a chain support to desk lid *x* and a hook to hold the lid in place when the drawer is closed. Bore holes to receive the drawer pulls and fit the locks and escutcheons.

Sandpaper all surfaces thoroughly. Finish in natural color, or stain if preferred. Give three thin coats of white or orange shellac, rub between coats with No. 4/0 sandpaper, and polish with wax.



Front view of the chest partly broken away to show a section through the end, a sectional view through center of case from front to back showing drawers and desk side, drawer and corner details

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

ETHYL or grain alcohol, which is called alcohol for short, is the result of the fermentation and distillation of fruits and sugars by yeast. Denatured alcohol contains, in addition to ordinary 95 percent alcohol, certain poisonous constituents.

Primarily alcohol is a solvent for soft resins. It boils at 78° C. and burns with an intense blue flame. It is the solvent for shellac varnishes.

Alcohol is a good dehydrating agent. It hastens the removal of water from photographic plates, films, and prints so that they may be used almost immediately after being made.

Solid alcohol is easier to carry about than the liquid and does not spill, but it

If they are first submerged in alcohol for a few minutes, photographic plates, films or prints will dry with great rapidity

does evaporate if not tightly covered. It is used as a fuel. The heat derived from it is the same as from the liquid.

There are two ways of making solid alcohol. The first requires the alcohol to be heated slightly on a water bath and stearic acid added until no more dissolves. Care is essential, and open flames must be kept away from the alcohol. Allow the alcohol to cool in a can or other container. The other method involves the use of a saturated solution of calcium acetate in water. Pour 15 cc. of this into 85 cc. of denatured alcohol and stir thoroughly. Almost instantly the alcohol will solidify.

A mixture of half alcohol and half water, to which ferric chloride (about a teaspoonful to a glass) has been added, is an excellent remedy to rub on the skin for poison ivy irritation.

A polish for woodwork to be applied with a brush may be made by dissolving 1 parts of shellac and 3 parts of rosin in about 25 parts of alcohol. A polish to be worked up with a rag consists of 4 oz. alcohol, 4 oz. raw linseed oil and 2 oz. of shellac; shake this mixture before using.

A thick solution of rosin in alcohol is a good noncorroding flux for soldering.

In order to clean glass without leaving a stain, wash it with a saturated solution of potassium bichromate in water, to which a few drops of sulphuric acid have been added. Then wipe the glass with denatured alcohol. If the glass is fatty, wash it first with lye water.

How to Patch Old Furniture

Workmanlike Methods of Concealing Nail and Screw Holes and Other Blemishes

By R. C. STANLEY

THE patching of wood is an art. Every handy man has frequent occasion to practice it. When done artistically, it is a credit to the mechanic; but done slovenly and crudely, it may be worse than the original defects which it replaces.

Patching, as described here, is for the purpose of preserving parts of antique furniture, and as the patches add to the percentage of new material in the piece, they should be as small as possible. The same principles, of course, apply to the patching of modern furniture and interior woodwork or trim of the better kind.

If a defect is caused by windshake, insert dowels across the grain, if possible, and patch the surface; if doweling is not possible, a dado (groove) may be cut across the back of the board and a spline or slip of wood inserted and glued.

If the blemish is a nail or screw hole, patch it. Don't use plugs, as they show end grain, which is undesirable in face work. Don't use bungs or face grain plugs put into holes bored with an auger bit this is all right in rough work which can be planed after the plugs are set, but in furniture repairing the spur of the bit will tear the wood enough to show an ugly circle in the finished work.

Fig. 1 Using a homemade bit gage for boring out the recess or "grave" for a large patch

IN NEARLY all old handmade pieces that have drawers, the parting rails between the drawers are from two to five times as wide as is really necessary Enough material usually can be obtained from this extra width to do all the patching required; this wood will always match better than new wood. In patching fine furniture, obviously we should make the inserts of material which matches the wood and not be content with fillers, putties or waxes such as are satisfactory on less important work that is to be painted and not left in the natural color of the wood

Patching wood is commonly called "graving", the name comes from the fact that a grave is cut out for the patch. The edges for the patch and the side of the grave should be slightly beveled as illustrated in Fig. 2 (page 97). The patch should be slightly thicker than the grave is deep so that when the clamps are removed the patch will be higher than the face of the work. It can then be dressed down flush.

To lay out patch and grave, a template should be made from cardboard. Lay the template in place and mark the grave with a sharp pointed knife, not a scribe, which will tear the wood. To lay out the patch, use the same template but mark with a pencil. In cutting out the grave, work to the knife lines; in cutting the patch, leave the pencil mark on.

In doing graving, chisels with extra long bevels should be used. Bevel edged chisels are the best, for they can be used in closer corners than square edged ones.

GRAVING should never be done at right angles to the grain of the wood. Several forms for patches are suggested in Fig. 2. *A* is wrong, as it crosses the grain at right angles, the others are satisfactory There is no limit to the number of designs possible. After some proficiency is acquired patches may be made in the shape of hearts, shamrocks, the leaves of different trees and almost anything the imagination may suggest—in effect, fine inlay work. The more complicated designs should be made of veneer about 1 28 in. thick

An aid in graving is boring out the center of the grave with wood bit and bit gage set to the proper depth; this gives the grave a flat floor. If a commercial bit gage is not obtainable, one can be improvised as shown in Fig. 1. It is a block of hardwood ⅜ by ⅜ by 1½ in., with a ⅛-in. hole bored about ⅝ in. from one end and a ¼ in. hole in the center at right angles to the ⅛-in. hole. The block is split through the first hole and across the second. Hold the two pieces over the bit shank with a ¼-in. stove bolt, nut and two washers. Insert a piece of wire, bent back at the lower end to prevent scratching, between the two blocks and tighten the stove bolt with a screw driver

Use a good grade of glue for patching. Apply it to both grave and patch. Insert the patch and

(Continued on page 97)

Patching Furniture

(Continued from page 96)

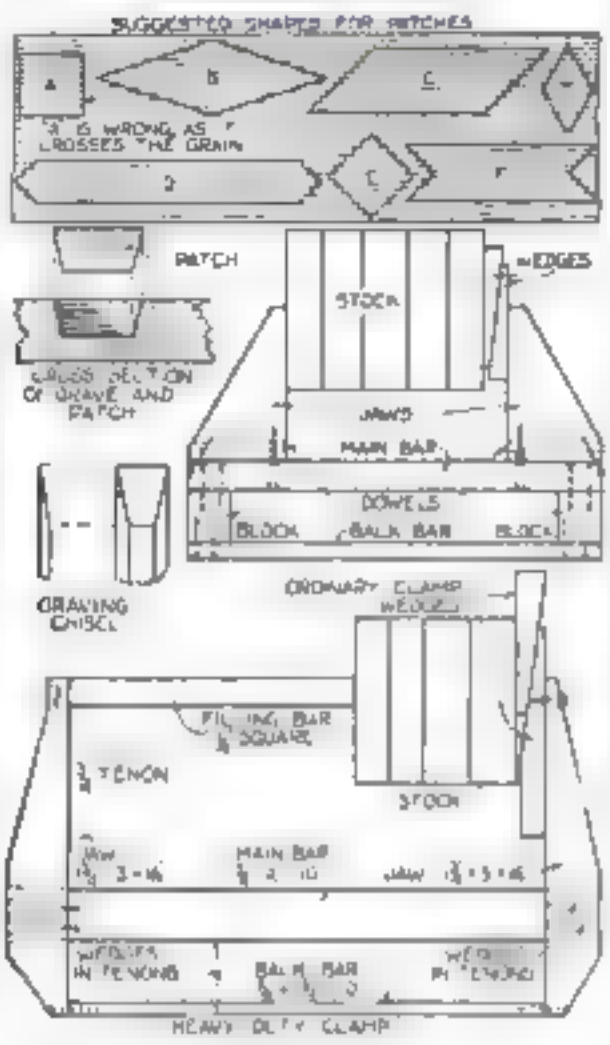


Fig. 2. How to make patches, a chisel for cutting recesses, and two homemade clamps

clamp it in place with considerable pressure.

A block of wood should be placed between the clamp head and the patch to distribute the pressure evenly. Allow at least three hours for the glue to set before removing the clamp.

Although hand screws or iron C-clamps are ordinarily used for applying pressure, it is a simple matter to make clamps in various sizes as shown in Fig. 2. The dowels through the head and tail blocks in the smaller clamp should be near enough to the end for the screws to pierce them, the screws will hold better than if driven only into the end grain of the jaws. The filling piece used in the larger clamp may be removed by drawing the pin through the tenon. Several filling bars of different lengths may be made so that the clamp can quickly be regulated to the size of the work in hand (Fig. 3). Both clamps may be made with a screw head as described for bar clamps in a preceding article (April issue).

The next article of this series, scheduled for early publication, will contain further suggestions on patching.

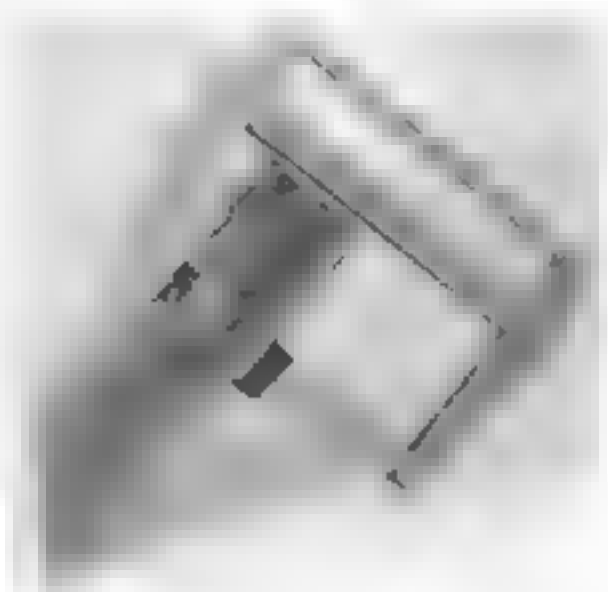


Fig. 3. Applying pressure to a patch with an inexpensive wooden clamp and wedges

Our *Mayflower* Sets Sail

(Continued from page 81)

The fully rigged Mayflower Complete the running rigging carefully with the drawing below

edge above the bonnet, and through blocks fastened under the top or to the eye of the stay. The main brace (B cord) starts right aft, leads through the pennant block, back through a block lashed to the taffrail, and belays to the cleat. The main sheet starts at the ringbolt in the third wale up, passes through the clew block, through a block just forward of its end, through a hole in the bulwark, and belays to a cleat. The main tack is a single rope which leads through the chestree and the bulwark. These latter should all be of B cord, but should not be rove off until later.

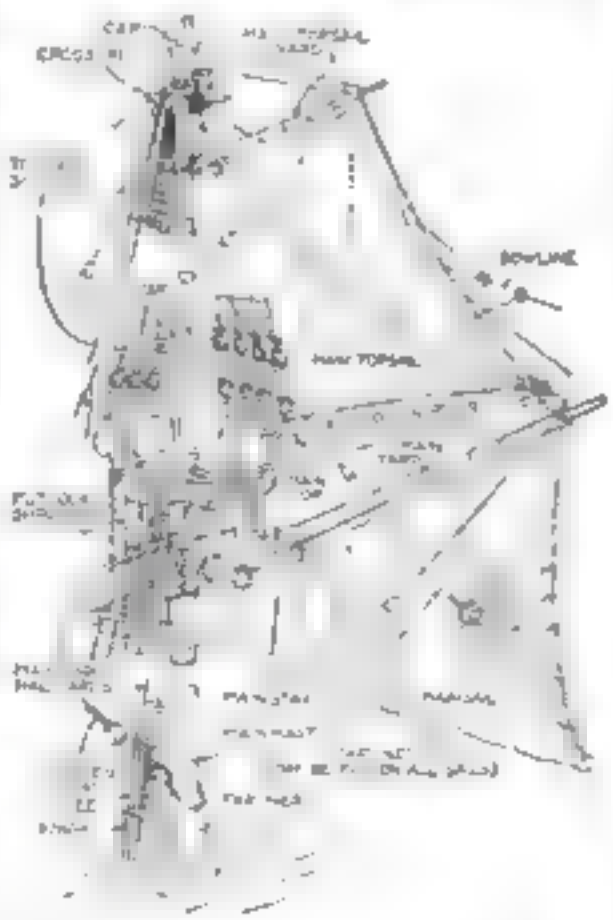
The foresail is rigged in the same way, except for the lead of some of the ropes The braces start at the mainstay, lead through the pennant blocks, through blocks lashed to the stay, and belay to the third pinrail, below. The sheets start at the ringbolts on the bulwarks abreast the mainmast, the ends coming aboard through holes below. The tacks reeve through the cleat under the cutwater, and the bowlines through blocks lashed to the forestay deadeye strap on to the second pinrail

As the foreknight is on the deck below, reeve the halyard through the holes in the little hatch, and when rove, nail it in position.

The mizzen has a large block strapped to it at the position shown on Blueprint No. 85. To the neck of this strap is fastened a parrel with only two rows of trucks and ribs. Seize a two-hole deadeye into the bight of a length of D cord, hitch both parts to the neck of the halyard block, and reeve them through the parrel. Then, when the yard is in position, reeve them through the holes in the deadeyes, hitch another cord to them, draw tight, and belay to the cleat on the knight.

To hoist the yard, hitch a cord to the crosstrees, reeve it through the block on the yard, through the hole in the mast head, and to a block similar to that at the fore and main but with only two holes, and reeve off the fall to the knight.

At the outer end of the yard there is a crow's-foot similar to a bowline, which leads through a block suspended from the mainmast head, through a block in the crosstrees, and downwards. At the lower end there (Continued on page 109)



How the main yard and the main topsail yard are rigged. The futtock shrouds are shown complete only on the port side. Note the parrel which joins main yard and mast

Blueprints for Your Home Workshop

ANY ONE of the blueprints listed below can be obtained for 25 cents. The blueprints are complete in themselves, but if you wish the corresponding back issue of the magazine in which the project was described in detail, it can be had for 25 cents additional so long as copies are available.

Popular Science Monthly,
250 Fourth Avenue, New York

Send me the blueprint, or blueprints, I have underlined below, for which I inclose .... dollars .... cents

No.	Title	Described in Issue of		Price
1.	Sewing Table	Feb.,	'22	25c
2.	Smoking Cabinet	*Mar.,	'22	25c
3.	End Table	*Apr.,	'22	25c
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9.	Arbor, Gate and Seats	July,	'22	25c
10.	Porch Swing	Aug.,	'22	25c
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45.	Pirate Ship—Details	Mar.,	'26	25c
46.	Galleon Model—Hull	May,	'26	25c
47.	Galleon Model—Details	*June,	'26	25c
48.	Sailing Yacht Model	*July,	'26	25c
49.	Broom Cabinet	Aug.,	'26	25c
50.	Airplane Model (Rise-off ground tractor, 36 in.)	*Sept.,	'26	25c
51.	Clipper Ship Model—Hull	*Oct.,	'26	25c
52.	Clipper Model—Details	*Oct.,	'26	25c
53.	Clipper Model—Rigging	*Nov.,	'26	25c
54.	Five Tube Radio Set	Oct.,	'26	25c
55.	Five Tube Set—Details	Oct.,	'26	25c
56.	Bird and Animal Toys	Dec.,	'26	25c
57.	*Constitution* Model—Hull	Jan.,	'27	25c
58.	*Constitution*—Rigging	Feb.,	'27	25c
59.	*Constitution*—Rigging	Mar.,	'27	25c
60.	Welsh Dresser	Mar.,	'27	25c
61.	Viking Ship Model—Hull	Apr.,	'27	25c
62.	Viking Ship—Details	Apr.,	'27	25c
63.	Toy Motor Boat—Hull	May,	'27	25c
64.	Toy Motor Boat—Details	May,	'27	25c
65.	Six Simple Block Puzzles	June,	'27	25c
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71.	Console Cabinet—Details	Nov.,	'27	25c
72.	Doll's House	Dec.,	'27	25c
73.	Doll's House Furniture	Dec.,	'27	25c
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76.	*Santa Maria*—Details	Jan.,	'28	25c
77.	Simple Pier Cabinet and Decorative Wall Shelves	Jan.,	'28	25c
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85.	*Mayflower*—Rigging	Apr.,	'28	25c
86.	Racing Airplane Model 35 in. twin-pusher type	May,	'28	25c
87.	Seaplane Model (30 in.)	June,	'28	25c

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(Please print name and address very clearly)

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He could be so good-looking—*but*

..*he has that half-clean look*

WHAT a disappointment! When she saw him across the ballroom floor he looked so attractive. But "close-up"? . .

Sometimes you *do* have to look closely to see pore-dirt. But there's pore-dirt in *every* face. Even after you wash and shave, pore-dirt lurks in your skin . . . sallow . . . gray.

The air you live in all day long, says the U. S. Weather Bureau, swims with millions of tiny specks of sooty gray. Even indoors you can see them in any shaft of sunlight. These tiny specks float onto your face, get into the very pores of your skin—wedged *under* the surface!

Once under the skin, no surface washing can ever budge pore-dirt. It's there "for keeps" . . . unless you massage it away with Pompeian Massage Cream.

Watch this pink cream roll pore-dirt free!

When you rub Pompeian Massage Cream into your skin, notice the clean, pink color. But after only a two-minute massage the same cream rolls out—actually gray with pore-dirt!

That's what this greatly enlarged photograph shows. See those dark marks? They are dried pellets of cream—loaded with pore-dirt that just a few minutes' massage rolled free!

Try it yourself tonight. Make sure that when she sees your face "close-up" it will have that fresh, ruddy glow that Pompeian Massage Cream gives. A clean, confident look that will make her say, "My, but you're looking well tonight!"

This FREE test convinces thousands every day!

Pompeian is 60 cents at every toilet goods counter. You're welcome to test it free. Simply fill in coupon and drop it in the mail. Do it now!

After a few minutes' Pom- [illegible]

POMPEIAN MASSAGE CREAM

The Pompeian Company, Dept. 901-G
595 Fifth Avenue, New York.
In Canada: 72 St. Ambroise St., Montreal.
Gentlemen: Please send me a free trial tube of Pompeian Massage Cream enough for two cleansing, invigorating facial massages.

Name ....

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How to Fill and Hide Wall Board Joints

Continued from page 93

a coat of glue size either on the joints only or on the whole wall, depending upon how the walls are to be decorated. The size stops suction and when the wall board is to be painted saves at least one coat of paint. Run the size well into the joints. When it is dry you are ready to fill them.

Various kinds of putty are sold for this work and will serve the purpose adequately, but the writer has had most satisfactory results in filling with one of the plastic paints sold for doing textured wall decorations. These come in dry powder form and are mixed with water into a stiff putty about like bread dough.

Reinforcing the Joints

Before the filling is done you should have on hand a sufficient number of strips of open-mesh canvas (or special soft wire screening made for the purpose) 3 in. wide to cover all joints as well as to place in all corners of walls and ceilings. Open-mesh canvas is a very strong fabric woven like a cloth mosquito netting, but with a three-ply canvas yarn. It comes in rolls of 50 yds. each, 36 in. wide, and the cost is reasonable. It can be purchased through decorators and paint and wall paper stores. Without reinforcement of this type, the joints will crack in time, for no putty is strong enough in itself to cement the sheets together.

Fill the sized joints with the stiff plastic paint putty and let that putty not only fill the joint but also spread about 2 in. on each side of it. While the putty is wet, place over the joint a strip of the open-mesh canvas 3 in. wide. Pound it down in close contact with a brush of some kind (a shoe brush will serve); then apply more putty on top of the canvas and scrape it down with a broad stopping or glazing knife, like a wide putty knife.

Be particular to work the putty out to a feather edge on both sides. You can smooth up the joint by scraping it with the knife. The fabric is thus embedded in the putty and securely cemented to the wall. If this is done carefully and all excess putty scraped off, the joint will be concealed perfectly. The surface then may be painted, calcimined or completely covered with open-mesh or other canvas, burlap or wall paper.

Decorating the Walls

A very good way to decorate walls of this kind is in a textured finish with one of the plastic paints.

Another practical and easy method is to paint the walls to gain a coarse stippled finish. The stippled finish looks like a fabric texture and something like coarse sandpaper.

The first step in applying a stippled finish is to size the wall with glue size, or a varnish size made from equal parts of good floor varnish and turpentine with a handful of dry pumice stone to a pot of size, or one of the standard ready-mixed sizes. Then mix white lead-in-oil with about one half boiled linseed oil and one half turpentine and tint with colors ground in oil. Get some torpedo sand such as is used for mixing concrete and screen it through a fly screen to take out the small stones. See that it is thoroughly dry and add it to the paint, about a quart of sand to a gallon of paint. Mix thoroughly and apply it to the walls and ceilings with a 4-in. flat wall brush.

After brushing the second coat well into contact with the surface, use semicircular strokes in a pattern that resembles the trowel marks of sand-finished plaster.

Smoother Stippling

If you prefer a stippled surface that is not quite so rough, mix the paint with a little less oil and more turpentine and then add to it about a pint of dry whiting to the gallon of paint instead of sand. Mix in the whiting thoroughly and strain the paint through a fly screen. When the paint has been applied and is still wet, stipple it with any large dry brush. A wall stippling brush is best, but it is an expensive tool. A painter's round duster will serve as well, although it will not do the work so rapidly. The stippling operation consists of pounding the wet paint all over with the bristle ends of the dry brush. Be careful not to skip any places.

The stippled paint finish is the most successful decoration from the standpoint of concealing any defects in the joints. Plastic paint textures are also excellent and wall paper with an all-over pattern is good. A lining paper had best be put on before the wall paper, however. Fabrics like burlap and canvas also may be used satisfactorily after the joints have been filled as described.

There are many who claim that a perfect and permanently smooth surface cannot be made over wall board joints, but it can be and has been done by careful workmen, and just as often by amateurs as by professional painters.

The use of putties and cement for special purposes, such as glazing broad wooden surfaces, will be described in a forthcoming issue by Mr. Vanderwalker, who is the author of many standard books on painting and decorating and is recognized as one of the leading authorities in the painting trade.

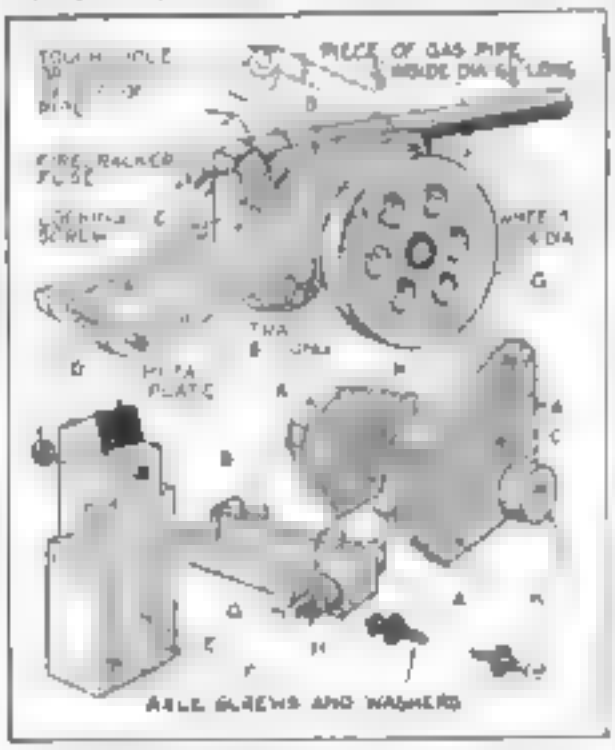
Decorating Ship Model Sails

FOR striping and decorating the sails and flags of ship models, tinted shellac like that used by lamp shade classes and available even at some ten-cent stores, can be used. It is first exposed to the air until it has thickened to the consistency of paint. It does not run on the cloth as do paints and thin shellacs, nor does it make the cloth thick and heavy, as it penetrates very well. If it is desired to age the appearance of the cloth still further, a mahogany or oak stain may be applied over the shellac. A. H. Pazy.

This Toy Howitzer Shoots Crackers

DESPITE drastic regulations in many cities, that old and dangerous Fourth of July combination—a small boy and a bunch of firecrackers—still exists in all parts of the country. It can be minimized in individual cases by constructing the relatively safe firecracker cannon illustrated. The cracker is placed in the gas-pipe barrel by tipping up the breech, and the fuse is allowed to project through the touch hole. With this cannon, a small boy is less likely to hold a firecracker in his hand to see what will happen when it goes off.

From any hardwood make two trail flasks *A*, ⅜ by 2½ by 8 in.; one trunnion block *B*, ⅞ by ⅞ by 3½ in., one buffer block *C*, ⅛ by 1 by 1¼ in., one trail pin *D*, ¾ by 2¾ in., one breech block *E*, ⅞ by 1 by 3⅝ in., and two cheeks *F*, ¾ by 1 by 1½ in., which are glued and



Only a piece of pipe and a few scraps of wood are needed to make this firecracker cannon

bradded to *E*. Prepare also one trunnion *G*, either hardwood or iron rod, ¾ by 2¾ in.; two trunnion sleeves *H*, ½ by ¾ in.; two sleeves *K*, ¾ by ⅝.

The two wheels should be ¾ in. thick and 4 in. in diameter with a ⅜-in. hole bored in the center, as well as six ⅝-in. holes with centers spaced on a circle 1½ in. from the center of the wheel. Gouge a groove in the top of *H* to receive a ⅝-in. (inside diameter) iron or brass pipe 6½ in. long. Fasten the pipe with wires.

Assemble parts *A* to *H* with glue and nails, but allow *E* to move freely on *G*. Drill ⅝-in. holes in *C* to receive 2-in. No. 12 round-head screws. Assemble sleeves *K* and wheels as the screws are driven. Use washers under the screw heads. Drill a ⅝-in. hole through breech block *E* to receive a ⅜-in. machine screw, and allow the thread to cut its own way. After a little use this breech locking screw can be turned by the fingers.

Cut a piece of tin, sheet lead, or sheet iron ¾ by 1½ in. for a breech lining and fasten with small nails. File the breech end of the barrel to fit this lining and file or drill the touch hole. Paint all wood black or dark gray.—C. A. K.

Decorative Metal Working

Continued from page 89

The upper block and blank are shown as if cut away to make the assembly clear

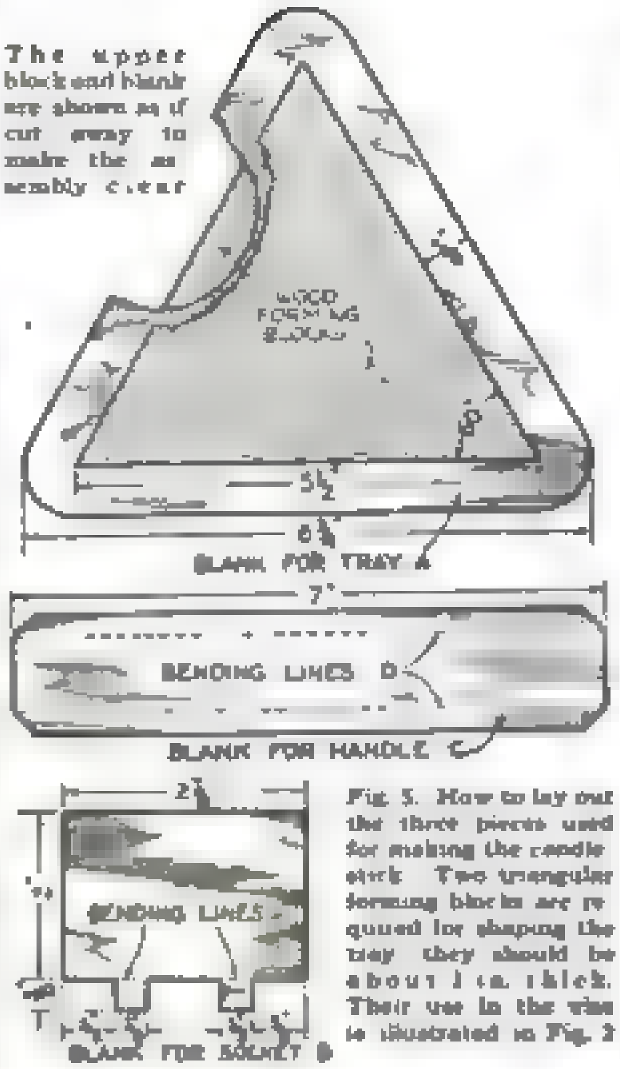


Fig. 5. How to lay out the three pieces used for making the candlestick. Two triangular forming blocks are required for shaping the tray; they should be about 1 in. thick. Their use in the vise is illustrated in Fig. 2

hold the handle together where the ends overlap (see Fig. 1). To do this, place the ring over a round wooden stick held in the vise and drill through both ends at once. Place a rivet through the holes with the head inside the handle. Rest the rivet head on the horn of an anvil, or a round piece of metal held in the vise, and hammer down the shank of the rivet with light, quick strokes. Generally the ball of a ball peen hammer is used for hammering rivets.

Now, after drilling the necessary holes, rivet the handle to the side of the tray as shown in Fig. 7. Finally, rivet the candle socket in place with the rivet heads under the tray. If you have trouble reaching into the tray with the hammer, use a tack hammer or a nail set or punch. If the rivet heads cause the candlestick to rock when it is placed on a flat surface, dome up the bottom slightly by holding the candlestick in one hand and tapping the bottom of the rivet heads lightly with a mallet.

If you have used bright, clean copper, it may be polished with any good brass polish. A soft, satiny finish may be given by scrubbing

Fig. 6. The edges of the handle are "hemmed" between strips of wood held in the vise jaws

it with powdered pumice stone and water. If you have used copper and wish to give it a dark finish, dip the piece in a solution of hot (not boiling) water and liver of sulphur—a piece of liver of sulphur the size of a hickory nut to a quart of water. The liver of sulphur, which may be obtained at any drug store, must be fresh. It should be kept until used in a tightly corked bottle. It is much used commercially to color copper and silver. Rinse the piece in cold water and allow it to dry. If it is desired to

Fig. 7. A bar of flat iron held in the vise supports the tray while the handle is being riveted in place. This and the preceding illustrations show operations frequently encountered in decorative metal work and model making

rub away parts of the coloring, this may be done with powdered pumice stone.

Another simple way to color copper is to scrape it clean with pumice, coat it lightly with machine oil, linseed oil, or turpentine, and heat it in an oven until the color you wish has been attained. Remove and allow it to cool. Another method is to heat the clean metal with a blowtorch. Experiment first on some scrap pieces, for if the heating is continued too long the work will warp or scale. This method, of course, cannot be used on soldered work.

Because of the interest many home mechanics take in constructing furniture, the next installment in this series, which is scheduled for early publication, will tell how to make simple hinges, drawer pulls, and key plates.

Cleansing Grease, Tar and Paint Spots

AMONG cleaning agents, carbon tetrachloride is one of the most generally used. It has the advantage of being noninflammable, but it has a tendency to leave a ring on fabrics unless it is thoroughly evaporated by friction while being applied. In the dry cleaning trade it is customary to use solvents that do not "wet" the material, and among these is a product known as xylene or naphtha solvent. It will remove almost any kind of a spot—grease, tar, paint, and other substances which do not actually stain the goods. It may be had in small quantities at wholesale chemical and drug houses.—C. L. NEWCOMB, JR.

Wood Turning

(Continued from page 84)

Fig. 6. The finished cabin with inlaid insert and border

firmly to the leg to be glued, and the other two force it tightly against the column.

The top may be octagonal, round, elliptical, or kidney shaped. It may be embellished with inlays or painted decorations, or it may be left plain. If it is to be fixed firmly to the base, a piece 1 by 4 by 18 in. with a 1½-in. hole bored in the center is screwed to its underside. The top is then fastened to the base.

If the top is to be made to tilt, two strips ¾ by 1 by 18 in. and a block 1 by 6 by 8 in., as shown in Fig. 7, provide the tilting mechanism. A 1½-in. hole is bored in the center of the block, which is later glued to the top of the column. Two dowels are also glued into one end of the block, and corresponding holes are bored in the side strips. The upper rear end of the block is rounded off so that the top can move freely.

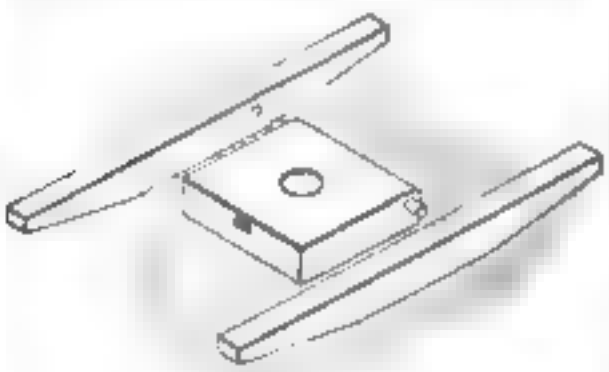


Fig. 7. The three parts which are necessary to mount the table if the top is to tilt

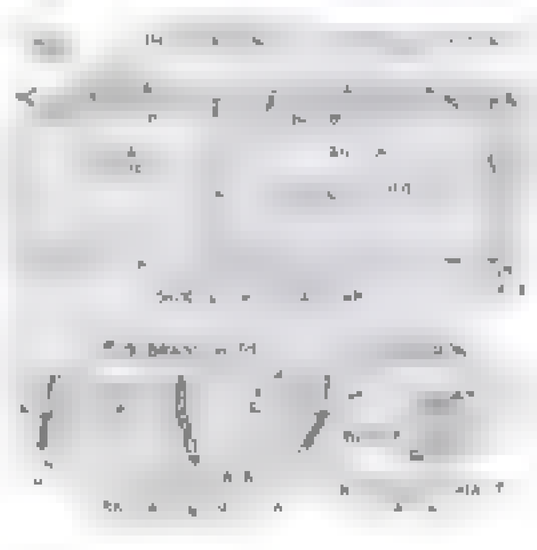
It should be remembered to glue the block to the column in such a way that one leg is perpendicular to the surface of the top when the latter is tilted to a vertical position, as otherwise the stand would be unstable. A brass catch, called a table catch, is screwed to the underside of the top and locks it to the block when in a horizontal position.

A "Rise-off-Ground" Model Plane

Continued from page 78

½ in. double-pointed brad halfway into the fuselage at the point where each strut is to be attached and force the ends of the undercarriage struts onto the other end, but first glue the end of each strut. The joint is completed by passing a piece of No. 28 brass wire through a small hole drilled ⅛ in. from the strut ends and then around the longerons. Secure the wire by twisting the ends. The small holes in the strut can be made by driving a brad into it.

The wheels, which are made of cardboard of the type from which suit boxes are made, should be about 1½ in. through the hubs. Make four flat cones by cutting a small section out of a disk and then gluing and wiring together the edges of the sections. The cones themselves are then glued and wired together



Side view of model; details of undercarriage strut fastenings and propeller shaft bearing

in pairs. After the wheels are completed and the glue has dried, they should be given a coat of airplane nitrate dope or bamboo varnish. If desired, a small piece of adhesive tape may be glued at the hubs to reinforce them.

The axle is piano wire $\frac{1}{32}$ in. in diameter. It should hold the wheels 4½ in. apart. The wheels are secured on the axle with a washer and the ends of the wire are turned in a small loop. The axle is bound to the undercarriage struts with silk thread and glued.

The propeller is of the wide blade or "club" type. It is made from a block of clear white pine ¾ by 1 by 8 in. Cut a paper pattern and draw the outline on the block. Cut along this outline to form the blank. The propeller is then carved out with a sharp knife. The rear side is concave and the front side is convex, while the contour of the cross section should resemble a wing curve. The finished propeller should be carefully sandpapered and balanced.

THE $\frac{1}{16}$-in. hole for the shaft should be drilled in the blank accurately before carving. The shaft is bicycle spoke wire $\frac{1}{16}$ in. in diameter and 3 in. long. With a pair of pliers, turn a rubber-hook on one end, pass it through the bearing, install a small copper washer and then force the propeller in place with the convex side forward. Next turn a tight loop into the end of the wire and sink the loop into the wood at the hub to key the propeller in place.

Give the entire frame and propeller one coat of bamboo varnish or dope. If desired, two-thirds of each propeller blade may be covered with China silk to prevent the blades from splitting in a severe collision.

The wings are of the single surface type. The main wing spars are white pine $\frac{3}{16}$ by ⅛ by 21½ in. These (Continued on page 1??)

A "Rise-off-Ground" Model Plane

(Continued from page 104)

Airplane Model Plans

AS IN the case of ship models, POPULAR SCIENCE MONTHLY was the first to realize the need for having simplified blueprints to aid its readers in constructing flying airplane models. Five are now available -No. 50, an "R.O.G." tractor of 36-in. wing span, No. 69, a 3-ft. flying model of the *Spirit of St. Louis* (this design was the first of the kind published in any magazine), No. 82, a single-stick 30-in. hand-launched model. No. 86 a 35-in. twin racer and No. 87 a 30-in. tractor seaplane model. In ordering any of these, please use the coupon on page 99.

spars should be well sanded. There are seven bamboo ribs $\frac{1}{16}$ by $\frac{1}{32}$ by 4 in., which are bent in an even curve, the highest point being one third the length of the rib back from the leading edge. The curve is $\frac{1}{2}$ in. high. One rib is placed in the center and the others are spaced $3\frac{1}{4}$ in. apart. There is an overhang on the spars of $\frac{1}{2}$ in. to which the tip outline is bound later.

To secure the ribs to the spars, first put a drop of glue on the rib location and then bind the rib with five wraps of silk each way.

The tip outlines are $\frac{1}{16}$ by $\frac{1}{32}$ in. bamboo and should extend 3 in. beyond the ends of the spars. Bind the outline to the inner edge of the spars with silk thread and glue.

THE front wing spars are a scant $\frac{1}{16}$ by a scant $\frac{1}{32}$ by 6 in. white pine. There are three ribs of bamboo $\frac{1}{16}$ by $\frac{1}{32}$ by 3 in. One rib is placed at the center and the others are spaced $2\frac{1}{2}$ in. apart. The tip outlines are bamboo $\frac{1}{16}$ by $\frac{1}{32}$ in. and extend 2 in. beyond the spars.

The wing covering is bamboo paper, which may be obtained from model supply houses. Glue along the spars, ribs, and outlines on the top side of the wing and then press the covering in place, smoothing out the wrinkles. Leave about a $\frac{1}{4}$-in. margin around the edges; this may be trimmed off with a razor blade after the glue dries.

After all the glue has dried, give the wings one coat of dope or two coats of bamboo varnish. The shrinking of the paper will draw the wings into a dihedral angle. To mount each wing, pass a rubber band over the wing and under the fuselage.

The motor consists of 8 strands of $\frac{1}{16}$ by $\frac{1}{32}$ in. flat, model airplane rubber.

Bamboo, bamboo varnish and paper and rubber can be bought from model airplane supply houses. Bamboo can be bent easily by heating it over a candle flame. The reed for the undercarriage can be bent in the same manner, although it is better to draw an outline on a board and drive brads around the outline to make a bending form. Soak the reed in water, put it in the form, and dry in an oven. It will then retain its shape. Never allow reed to become too hot, as this makes it brittle.

This model will make wonderful flights of a thousand feet or more. It is exceptionally stable and can be flown in the wind, either launched from the hand or taking off under its own power. Always fly the model down wind, that is, with the wind. The rubber may be safely wound 250 turns.

The wings should be adjusted so the model will make an easy glide to the ground. If it climbs too fast and stalls, slide the rear wing backwards. If it fails to climb, slide the rear wing forward. After a few adjustments, the correct location will be found.

A definite program for getting ahead financially will be found on page four of this issue.

Steel Ball *Magic* for Mechanics

(Continued from page 82)

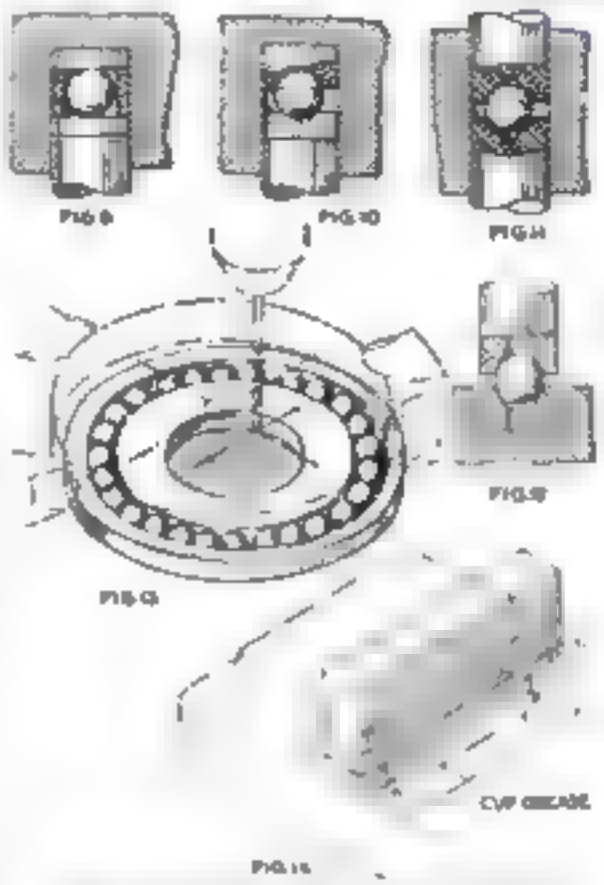


FIG 14

Thrust bearings, a work support for delicate drilling operations, and a simple method of using balls to take the place of parallels

used here, too, especially as the two holes will rarely ever meet exactly face to face

Figure 4 shows a way of employing steel balls in a comparative hardness test In the October, 1927, issue of POPULAR SCIENCE MONTHLY, the writer explained a way of using a ball test to ascertain the comparative hardness of a blanking die against the sheet metal to be used Here we have such a comparison of material against material It can be used to good advantage, for instance, to ascertain if a new batch is of the same hardness as previous orders. The test can be carried out in any fairly heavy vise A ¼- to ½-in. steel ball is placed between the two samples, the surfaces of which should be polished. Several impressions are made and the corresponding indentations in the two pieces compared. Any marked difference in hardness will be apparent to the unaided eye in the slightly different size of the impressions or they may be measured by means of a high-powered glass and a fine scale, and the figures obtained compared.

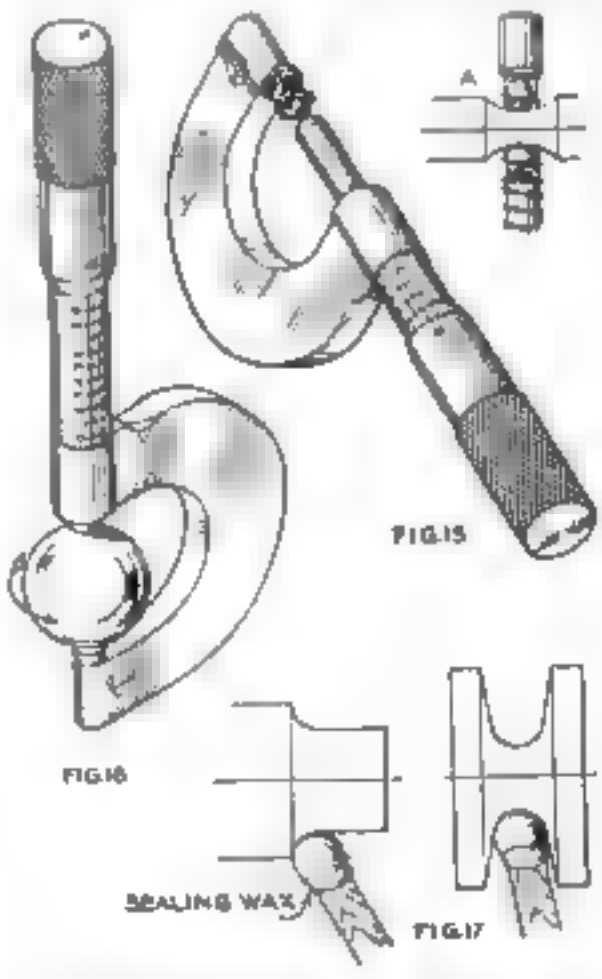
SOMETIMES a set screw having a true spherical point is needed. A combination which will answer admirably in many instances is that shown in Fig. 5. The ball should not be too large, and the proportion shown in the drawing should not be much exceeded. A little dash of hard grease placed in the cup of the screw will hold the ball. Figure 6 shows one use of such a ball set screw and incidentally illustrates a quick way of producing a light center type pivotal bearing. A ball once, forced into a spotted hole, may be used instead of the second screw. The pivoted member is placed between the two balls and indented by setting up the screw hard. When the screw is slightly released, the two impressions thus formed serve as bearing surfaces. A bearing of this kind is quickly made, requires little work, and is free from wear due to disalignment.

Another use of a ball-point set screw is shown in Fig. 7. Here it serves as the adjustable follower member in the tail of a cam lever which is actuated by the double incline *A*. An incline of almost any profile may be followed in this way. Where adjustment is not necessary, a ball only, seated in a shallow hole in the cam lever, will do.

In Fig. 8 is given one instance out of many where a steel ball may be made to serve as a semipositive catch such as are sometimes required in special tools, jigs, and fixtures to hold a part tightly at several stations. In this particular example, we have a pin which is to be so held when halfways pulled out. The pin seat is bored with a V-shaped groove, and the pin is provided with a cross-drilled hole in which two balls, urged outward by a coil spring, are located. This arrangement gives a well-defined hold, yet allows the pin to be readily disengaged or turned. By reason of the high polish and the rolling action of the balls, the hole, even in a soft part, is not scratched or marred. A hole should be used instead of the V-groove where it is desired to hold the shaft against rotation as well as to register it longitudinally. Where a 90-degree groove is used, it should be about the width of the ball diameter, as shown at *A*. If a hole is to serve as stop, it should be less than nine tenths the ball diameter

THE mechanic who needs a ball bearing will almost always do best to buy it. One exception is the single-ball thrust bearing such as is frequently found in small drills and can be applied to many other mechanisms. For all ordinary purposes, a plain hardened and polished surface at either side of the ball as in Fig. 9, is best. In that case the ball should be allowed only a small amount of lateral play in the seat. The arrangement in Fig. 10 is not a ball bearing, properly speaking, as the ball is constrained to remain fixed with respect to the upper member in which it has a larger surface contact. Such a bearing therefore does not essentially differ from one where the plain hardened end of a shaft revolves against a bronze washer. One advantage, however, is that the ball provides a highly finished, accurate, and readily renewable bearing surface. In a bearing of this kind, the bronze washer should be given a slight lateral play so that it can adjust itself with respect to the ball

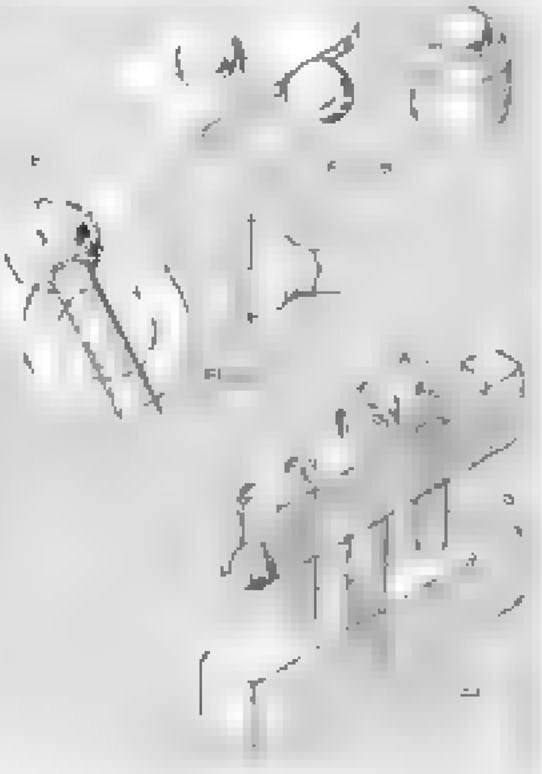
Finally, the "don't use" kind of bearing is shown in Fig. 11. Here the ball is mounted between two hardened (Continued on page 107)



"High duty" balls will serve as micrometer standards and assist in difficult measuring

Steel Ball Magic

(Continued from page 106)



Balls can be used as limit gages, for inspecting the bore of work in the lathe, and for making adjustable snap gages as illustrated in Fig. 20

90-degree centers, with the result that it is compelled to slide on one or both. Such an arrangement should be used only for centering two parts on each other as in Fig. 18.

Thus far we have put balls to rather rough work. Let us now see what they can do on more delicate jobs. Did you ever wish, in drilling small, accurately located holes, that the work would center itself better on the drill? In some instances it can be done by placing it on a bed of balls. One way to improvise such a bed of balls is shown in Fig. 13. All we need are two light, flat rings or washers—these can be found among the odds and ends in any shop—of proportions such that, say, ¼- or ⅜-in. balls can be placed in the annular space between the two rings and will extend beyond the top of either. As drill tables are apt to be pitted, it will usually be best to place the arrangement on a plate and this on the table. The work may rest directly on the balls or be clamped to another plate and this placed on the balls. Different degrees of sensitiveness in the floating action can be obtained by varying the weight and size of the rings and the clearance of the balls between them.

STEEL balls often may be used to take the place of parallels for blocking up work in miller or grinder vises. Stick the balls on with a daub of cup grease and they will stay put. Figure 14 shows a case where regular parallels could not be used at all.

Why should the precision qualities of steel balls not render them fit for measuring uses? As a matter of fact, there are ways of putting balls to work in this capacity. After years of trouble on the part of mechanics in measuring tubular parts, a firm of toolmakers has finally brought out a little device which slips over the end of the micrometer and holds a ¼-in. ball against the face of the anvil. Meanwhile, for emergencies, it is well to remember that a daub of hard grease placed on the anvil will hold the ball while a few measurements are being taken. A better arrangement can be rigged up in a couple of minutes by the simple procedure of Fig. 15. Take a short piece of small, dead-soft wire. With the micrometer held in the left hand, take two turns of the wire around the end of the frame under the anvil, then two turns around the anvil, and a slightly smaller turn or two around in front of the ball. The same idea may (Continued on page 108)

Steel Ball Magic

(Continued from page 107)

be applied to the spindle where it is necessary to measure a surface turned at an internal radius, as at A. For the spindle, a permanent device may be wound from spring wire and, with the ball held in it, kept for future use.

AN EXCELLENT use of 1-in. "high duty" balls is as shop standards for micrometers. In several respects steel balls are ahead of regular standards for such checking. This does not mean that they can or should replace these standards, which should be kept on hand for ultimate reference. The advantages of a steel ball are that it costs only a few cents, has a very large measuring surface, and gives a point contact so that it is always aligned. The micrometer is held vertically, as in Fig. 16, and the ball rested on the anvil. At a certain sharply defined pressure, which coincides with the ideal measuring pressure of the spindle, the ball can be made to spin freely with the fingers, but will immediately slip or refuse to turn if the pressure is decreased or increased.

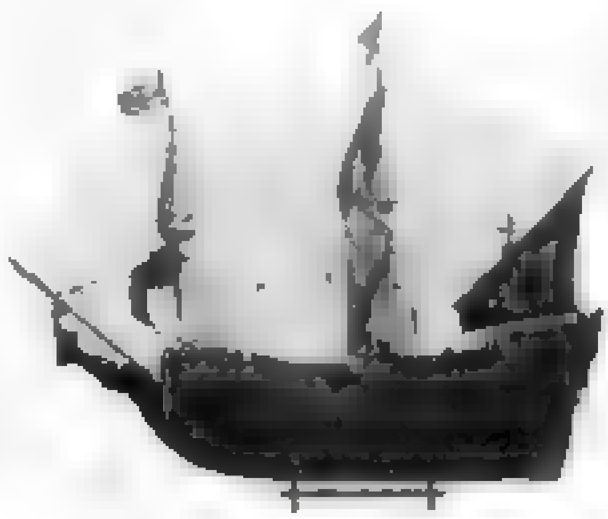
A radius gage is a good thing to have, but one may not always be on hand. If it is an internal radius of standard size that is to be made—and most radii are—a steel ball will do admirably. It may be held in the fingers if fairly large, or it may be slightly heated and stuck to the end of a small rod or stick with a bit of sealing wax, as in Fig. 17. The right-hand view shows one case where a steel ball will work when a radius gage will not, because it could not enter the narrow groove.

IN SOME classes of work steel balls may be used as internal gages, both for production gaging and at the lathe in checking the diameter of a bore. Grade-B balls, which vary within .001 in. plus or minus, should be chosen, as it will usually be possible to find balls varying by the required small differences from bores of standard dimensions. In Fig. 18 a pair of plain balls is employed to limit-gage a reamed hole in a stamping, and the bore in a screw machine product. Because of the fact that the entire surface of the ball is its gaging surface, and that it is extremely hard and highly finished, steel balls used in this manner wear more slowly than any other form of gage.

In inspecting the bore of a piece made in the lathe, a steel ball may be used by soldering it to a rod as in Fig. 19. It is necessary to be very sure that the ball is firmly soldered in place so that there is no danger of its coming loose. Even so, it should never be forced into the hole and only used to "feel" how the bore is coming. The face of the ball may be ground off to allow it to work close to the end of a hole. In that case, however, the ball should be checked afterwards to see if any variation in shape has occurred.

The writer knows of no adjustable snap gage which is as simple and covers as wide a range of sizes as the one illustrated in Fig. 20. It consists of two steel bars *A* and *B* connected by a central screw and spread by two set screws. Bar *B* is hardened, bar *A* is soft and has a pair of steel balls set into shallow seats near each end. By having sets of screws of different lengths, any size up to several inches may be taken care of by the same tool. In setting the gage, blocks of the required size are placed between the jaws, and the center screw is set up hard. Then the set screws are tightened until the blocks can slide.

The combination of the plane surface of the lower bar *B* with the spherical surfaces of the balls, renders this gage independent of any consideration of nice alignment. While the tool is not as rigid and is necessarily less accurate and dependable than a regular commercial snap gage, nevertheless it makes a good small-lot production gage for many kinds of everyday work.



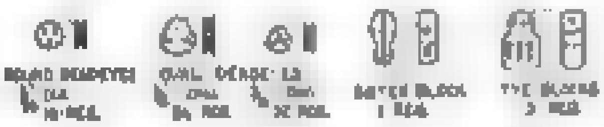
The *Mayflower*

(Continued from page 96)

are bowlines, which are single ropes leading through blocks lashed to the main rigging. It may also have martinets from its after edge and a buntline from the foot to the crosstrees. The clew has a single sheet block toggled to it, with the fall leading through another block strapped to a staple in the deck, right aft, amidships.

The topsails have one block at either quarter for the clew lines; they have brace pennants seized at the yardarms and single blocks for the lifts at the same place and under the crosstrees.

The parrels are single ropes with an eye in one end. The bight, with the eye just projecting, is seized around the yard; the other end



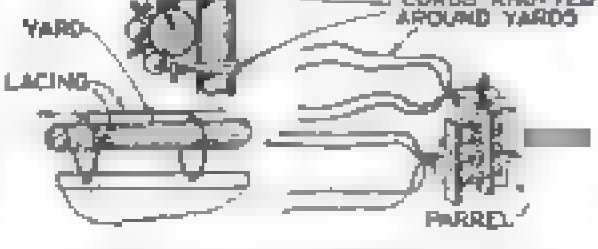
Deadeyes, blocks and bull's-eyes required for rigging the *Mayflower* completely. These may be made from strips of boxwood, holly or gumwood, or bought from a dealer in ship model supplies. Speed in making these parts depends upon starting with strips of the right cross section and doing the drilling, grooving, cutting off and sandpapering in order

goes around the mast, around the yard, back around the mast, and through the eye, to which it is hitched or seized.

The halyards (B cord) are hitched to the yard and led through the sheaves at the masthead; they have blocks spliced in their ends to lie just below the tops when the yards are hoisted. A thinner rope (C cord) bolts to the deck on one side, leads through the tie block, and ends with a block on the more side. Through this block and another block at the deck, the fall is rove. The final tackle comes to the starboard side at the fore and to the port side at the main.

The clew lines are rove off as far as the courses below. The sheets are single ropes toggled or hitched to the clews (lower corners), and lead through the larger blocks at the yardarms and at the quarters under the lower yards, belaying to cleats on the mast.

The topsail braces (C cord) lead from the eye of the mizzenstay, through the pennant blocks, through blocks lashed well up on the mizzen rigging, and (Continued on page 110)



How to make the parrels which connect the main yard and the fore yard to their masts

The *Mayflower*

(Continued from page 109)

through blocks lashed about halfway up on the main rigging. The main bowlines lead through blocks lashed to the main topmast stay. The fore topsail braces are rove like the fore braces but to the stay above. The fore bowlines lead through blocks on the fore topmast stay, and through blocks on the bowsprit. They may have buntlines.

The spritsail has a halyard block strapped to it at the center, forward. It has clew line blocks strapped underneath about halfway out and to the other ends, brace pennants with blocks and garnet blocks, and between the clew line blocks and yardarms there are lift blocks above.

The yard is parreled to the bowsprit like the topsail yards. The halyard, which is rove through the yard block and through another strapped to the boom end, is belayed to the cleat on the side of the bowsprit.

THE garnets are rove through other blocks near the bowsprit end. The lifts start at the forestay, reeve through the blocks on the yards, and through the blocks on the stay. The braces are similarly rove higher up the stay and finally lead through the blocks lashed to the headrails. The spritsail sheets have long pennants with their hauling parts starting at bolts near the break of the forecastle and coming aboard below the fore sheets. These sails also may have bowlines to haul them up snug.

When all the gear is on, the braces should be rove off and hauled tight for whatever position is chosen for the yards—squared for the wind aft, or braced in for the wind on the quarter or ahead. The model, I think, looks best with the courses and one clew of the spritsail clewed up, but all may be set full, all may be clewed up, or, indeed, they may be left off altogether.

The anchors may be made from brass or lead, or bought ready-made. The shanks should be about 1¼ in. long with wooden stocks of about the same length. The latter are best made by shaping them, then splitting them in half, fitting them to the shank, and gluing and riveting them together again.

The cables will be three parts of A cord laid up, with one end stapled into the hawse pipes and the other outside—hitched to the anchor ring. They are lashed to the fore rigging.

EXPERIENCE has taught me that flagpoles are always getting bumped and broken, so now I make them of rattan cane, which bends. The flags can be painted on thin white silk with water colors, using a spot of gum in the water to prevent the color spreading. Instead of hemming to prevent fraying, it is neater to run a line of thin shellac around the edges.

The flag at the fore is white with the red English St. George's cross; that at the main has in addition the red diagonal cross of St. Andrew (Scotland) on a blue ground, with a thin white edging between the red and blue. This is not the present-day Union Jack.

With a touch of color here and there to brighten up, and an occasional rub with pumice stone or very fine sandpaper to dull down, your model is complete and ready to start on her long voyage of conjuring up adventure and romance for you; to remind you of those hardy men and women who were the pioneers in the settling of the northern part of our country. Not for them was there a steam heated, electric lighted, floating hotel, driven at high speed by turbine engines, but only this sturdy little ship with which they braved the terrors of the Western ocean to uphold a conviction and start life in a new country with incredible hardship but with liberty.

Next month—an article by a naval officer on simplified sails for ship models.

I Can Peer into Your Stomach

(Continued from page 58)

eyes into a hole in the stomach wall of a trapper who had survived a frightful gunshot wound. This frontier physician made important observations, thanks to this accident, just as Harvey in an earlier day had looked into another wounded man and learned how blood courses in our arteries and veins. Before the discovery of Roentgen rays almost all studies of anatomy, except for these rare accident cases, had been made after death. Imagine, then, what a boon this discovery was to those physicians who are not content with merely inheriting medical knowledge but desire to add to it. Now they were able to study living anatomy. One of their surprises was to discover the constant churning and writhing and contracting that goes on within the abdominal walls of men, a performance as unnerving in the living as the pumping of the heart.

THE first doctor who saw in a fluoroscope screen the shadows of a stomach in action saw something as previously remote from human intelligence as if he had suddenly been given a peek at the other side of the moon. Henceforth doctors were not required to go about their work of finding out interior afflictions in the manner of blind piano tuners. Their ears had been made keener by stethoscopes, and they had used straps and little buckets to pry into the behavior of stomachs. Far too often the surgeon's knife had exposed the things hidden from their eyes, but Roentgen had placed at their disposal a magic eye that saw through solids.

All this does not mean that the corner grocer or the garage man can look into a fluoroscope screen and correctly interpret the condition of the human organs shadowed there. Even medical men have to acquaint themselves with the Roentgenological appearance of the structures revealed to them before they may employ it in diagnosis.

I speak only for myself, of course, but I believe that any skilled Roentgenologist can just about tell your fortune with a fluoroscope. With it he can learn vital facts about the state of your health, and today as never before, sound health means sound fortune. Expert interpretation of shadowgraphs on a fluoroscopic screen calls for a fine degree of medical skill, but it is a skill that increases steadily. Reuter, a German scientist, baffled by his inability to distinguish clearly the stomach shadow from that of the intestines, was the first man to conceive the notion of administering salts of high specific gravity to his patients. He used bismuth, which made a [illegible] shadow that gave the outline of the stomach. Fancy yourself trying to see in the twilight a sack made of transparent material against a background of similar material. It is impossible, but if you fill the sack with a darker substance its outlines and form become perceptible. Nowadays we place a patient against the fiber wall behind which is the X-ray tube, swing the suspended screen into position, hand him a pint or so of barium in solution, flavored perhaps with pineapple, and then command him to drink.

IN THE aquarium tanks where captive fish are behind plate glass, as if in a show window, one may see moving shadows swim into view. Somewhat similarly does one see who watches in a screen illumined by Roentgen rays as the dark shadow of the solution moves downward through the channel of the esophagus. What happens thereafter is of importance to the individual under observation. The shadow begins to thicken and swell until it has become the shape of a sausage fashioned like a fishhook or a cow's horn. The "contrast meal" the patient has been swallowing has accumulated in his

(Continued on page 113)

I Can Peer into Your Stomach

(Continued from page 111)

stomach. What will the stomach do with it? If there results a kind of rhythmic series of contractions whereby a thin stream of the darkest shadow is squirted into the beginning of the intestine, he is a lucky man. If there is an irregular spasmodic twitching of that sausage-shaped shadow it usually means that the patient has been stuffing himself with too much food, smoking too much, working too hard, and sleeping not enough. He is suffering from nervousness.

An ulcer would reveal itself in that stomach as a protuberance on the shadow, because the barium would have filled the depression eaten into the wall of the stomach by the ulcer. But a cancer is seen as a hole out of that strangely swollen sausage because the X-rays pass through such malignant tissue but not through the barium in which its matrix is imbedded. At intervals that barium meal may be followed on its journey through the intestines, a column of shadow that tells a doctor more about an individual's digestion than could be found out in any other way short of an exploratory operation.

THERE came to this country recently for a visit a Parisian physician named Forestier. It was he who first thought of putting into the lungs poison suspended in oil as a contrast substance for the purpose of showing the diseased condition more clearly. There is a form of tumor that sometimes develops in the spinal cord. Removed, it does not come back, but if allowed to grow it will cause complete paralysis. Formerly surgeons had to open four or five vertebrae to find the tumor. Now they inject a few drops of iodine and oil into the spinal canal. In the fluoroscopic screen that blob of lipiodol, heavier than the spinal fluid, becomes a dark shadow that moves, as the patient is tilted, in the manner of the air bubble in the spirit gage of a carpenter's level. If there is no tumor to obstruct the way the dark round shadow rolls smoothly to the bottom of the spinal canal. If there is a tumor, it obstructs the passage of lipiodol, and where the shadow stops, there is the place to operate.

THERE is almost no danger any more to the patients who submit themselves to fluoroscopic examination by a physician who understands Roentgenology, because the studies are not prolonged. The danger menaces the examiner. I, and others who expose themselves every day, must take certain precautions to keep those invisible rays from inflicting a burn that would be equally invisible until, after several years, it disclosed itself as an incurable and fatal condition. I must wear a leaded apron, lead glass goggles, and rubber gloves impregnated with lead as an armor against the lethal quality of this otherwise benevolent tool of medicine. Carelessly dealt with, it might shorten the life of anyone rashly exposed to it. Wisely handled, it is going to add years to the average life span of life. In time to come everyone in civilized countries will go to a Roentgenologist and have his fortune told by means of these revealing shadows at least once a year.

Physicists, like physicians, are using X-rays to look into the vitals of industry and foretell its future. You won't want to miss a remarkable article in this magazine next month telling of marvelous discoveries about the interior structure of metals, and how these discoveries are being used to make better machinery, airplanes, and automobiles.

How "Bootleg" Gas Ruins a Car

(Continued from page 70)

run it on anything you want. But just remember that there's no such thing as pure gasoline. All gasolines are mixtures of liquids that are chemically different. Some kinds of gas are made up of liquids that evaporate real quick, and your motor starts easily when you use them, others don't burn so well. And into bootleg gasoline go a lot of heavy, cheap, hard-burning oils. A good part of it never burns, but gets down in the crank case and dilutes the lubricating oil. The explosions have no snap, so you have to open the throttle fairly wide to get ordinary driving speed. Also, the heavy compounds turn into carbon and gummy deposits.

"You get less mileage with bootleg gasoline," Gus continued, "so the cheaper price doesn't mean anything. The car starts harder, especially in cold weather, so you get more wear on the starter motor and the battery. The excessive crank case dilution means you either have to change your oil oftener or you wear out the moving parts faster, and to top it all, the cheap, bootleg gasoline probably contains sulphur. This turns into acid when burned in the cylinders and causes corrosion and extra wear, especially on the cylinder walls, piston rings, pistons, and valves."

"WHY should they want to substitute the heavier liquids if they don't burn well?" asked Cradlock. "And it ought to be easy enough to filter out the sulphur."

"The heavier oils down to kerosene and even below that—the kind of stuff suitable for use in oil burners—are used to dilute the mixture and make it cheaper. And you can't just filter the sulphur out like straining dirt out of water. It takes a costly chemical process to get rid of the sulphur, as the big refining companies can tell you."

"Maybe you're right," Cradlock grudgingly admitted. "I do have to adjust my carburetor every few days, and now that I think of it, I've had to adjust for less gas each time I've bought expensive gas."

"And I'll bet the oil in your crank case is diluted till it has no more body than so much dish-water!" asserted Gus.

Cradlock, now thoroughly alarmed, decided to have his crank case drained. The lubricating oil flowed out swiftly, and proved but little thicker than kerosene.

"You win, Gus," Cradlock grunted as he inspected the black, smelly liquid, "but how am I to tell when I'm getting good gas? It all looks alike, and you say that some of the worst bootleg gasoline comes out of pumps that are labeled with standard brands."

"WHENEVER you can, buy your gas near home where you know the dealer is honest," Gus recommended. "Jim Barrows, who has a filling station out near your place, is as square as a die. He'll give you what you pay for. Then if you have to buy gas on the road, find a filling station that's run by a refining company. Whatever you do, stay away from these pumps stuck in front of candy stores, hot dog stands, and so on.

"The special, high test gasolines and ethyl gasolines that cut down the knocking save wear on your motor, especially on the connecting rod and wrist pin bearings, and you actually get more mileage. You won't need to have the carbon scraped so often and you'll be able to go faster on the level and up hills."

"By cracky, it ought to give new life to this bus if it will do all that," Cradlock observed enthusiastically.

"It does if the motor is in good mechanical condition," agreed Gus. "But no gasoline is going to cure leaky valves, bum compression, and bad ignition. You can't cure broken bones with medicine, you know."

Germany—Olympic Dark Horse

(Continued from page 83)

400-meter events. At the top of our list I place Charley Borah, of the University of California and the Hollywood A. C. national champion at 220 yards, and intercollegiate champion at 100 and 220 yards. Borah, Rosand Locke, and Jackson Scholz look like our best bets.

In both sprints Germany will be our most dangerous rival. The German ace is Helmut Koerng. In Leipsic two summers ago I timed his 100-meters in ten and three-tenths seconds, a tenth-second under Charley Paddock's official world's record.

In the 5,000-meters the Finns, with Paavo Nurmi, Willie Ritola, and Kinnunen, seem likely to get the lion's share of the points. Our best hope, I think, is Lee Lermond. In the 10,000-meters it looks like Nurmi first, Ritola second, and the rest of the field nowhere. Perhaps our Indian, Plu Ouf, will gather in a point or two. Russell Payne, formerly of the University of Pennsylvania, looks like our best bet in the 3,000-meters steeplechase. Ritola probably will win, with Hodge, of Great Britain, second.

THE first Marathon I had the pleasure of watching was the twenty-six-mile jaunt in St. Louis in 1904, and I've never heard anyone say it lacked excitement. The 1904 Games weren't much more than glorified American championships, but there were a few foreign competitors and one was Felix Carvajal, a little, dusky Cuban.

No plutocratic athletic association sent Felix to St. Louis via steamer and Pullman. He did his training by running around a dusty square in Havana, while his brother held a tin cup for offerings of sport-loving Cubans. After a while he had enough to pay for his ticket to St. Louis, where he ran the other Marathoners dusty. At the end of eighteen foot-blistering miles, when he had a comfortable lead, he picked up three or four green apples that lay under a tree, and ate them as he ran on. A mile down the road terrible cramps seized him and he lay helpless and watched runner after runner pass on down the dusty path to glory.

WHILE little Felix lay suffering, Fred Lorz was supplying the comedy relief. Lorz dashed gallantly into the stadium and across the finish line and was crowned with laurel by Miss Alice Roosevelt and photographed in various graceful poses. Then it developed Lorz had hopped aboard a truck and ridden ten miles. The laurel was placed on the perspiring brow of a gentleman named Hicks who had run all the way.

This year's Marathon winner? You can pick him as well as I. But it would be glorious if our veteran Clarence DeMar should crown his remarkable career with an Olympic victory. He has as good a chance as anyone. So has Whitey Michaelson. So has young Myles, of Nova Scotia—and Stenroos, the Finn who won in 1924.

One of the interesting things about the big weight men is that they are so good at "starting something." It was gigantic Ralph Rose, biggest and greatest of shot putters, who at London in 1908 "neglected" to dip the American flag he was carrying in the parade when he passed the box occupied by the King of England. Afterward he explained that he "forgot it." If so, his forgetful nose caused what was almost an international incident.

Another interesting thing about the big boys who toss the heavy weights is that they seem to go on forever. There's Matt McGrath. He's over fifty and a captain in the New York police, and he's been on four Olympic teams—and he's out to make his fifth. I think he'll do it. He's a hammer thrower, with an Olympic championship and three Olympic seconds to his credit. We have an even chance of winning the hammer throw.

Herbert Schwarze, John Kuck and, if he competes, Bud Houser look like our best in the shot put. We have a good chance for first. Houser will have an even chance in the discus throw. Krenz, our national champion last year, should be good for a place.

With Charley Hoff, the great Norwegian pole vaulter, Sabin Carr, of Yale, world's record holder, will have at least an even chance. With Hoff out, we should win both first and second.

FOR the broad jump, I'm banking on our DeHart Hubbard. He's the only man in the world who can jump twenty-five feet consistently, and he often goes over that. Harold Osborn should win the high jump, with Burg, of the Chicago A. A., second.

We will take eight quarter-milers to Amsterdam—four for the 400-meters, and four for the 1,600-meters relay.

Great Britain will be our strongest rival in the 400-meters. D. G. A. Lowe, who has run 440 yards in forty-eight and four-fifths seconds, is the best of the Englishmen. Joe Tierney, of the New York A. C., who has done forty-seven and nine-tenths seconds, should be our brightest star. We have an even chance for first, and we should get an even break on points. We should win the 1,600-meters relay race, although Great Britain and Germany will be strong contenders.

Fifteen hurdle events have been held since the revival of the Games in 1896, and we have won fourteen of them! This year we should repeat.

In the shorter hurdle race, Germany again looms dangerous. In Truebach the Germans have one of the world's best high hurdlers. But I doubt if he can keep up with Americans such as Monty Wells, of Dartmouth, Intercollegiate A. A. A. A. champion; Werner, of the Chicago A. A.; Dye, of Oklahoma; Parker, of the New York A. C.; and Reynolds, of California. I'm counting on first place, and better than half the points.

IN THE 400-meters hurdles, we should win both first and second. F. Morgan Taylor probably will be our headliner, with Johnny Gibson, and Spencer of the Olympic Club of San Francisco not far behind him.

In the Decathlon, the ten-event competition for all-round athletes, Yrjola, of Finland, who last year bettered Harold Osborn's world's record, is the logical favorite. Fast Eikins, the Indian student at the University of Nebraska, looks to be one of the best of our men, and Berlinger of the University of Pennsylvania has great potential possibilities.

In this year's Games, I look to see our athletes win about as many firsts as in 1924, but I'm doubtful about their scoring as many points.

"How on earth do they stand it?" you ask, as you listen over the radio to the description of terrific blows exchanged by boxing champions. Next month an expert who knows all the fine points of the game will tell the answer in this magazine. What makes boxing champions—how they harden themselves to withstand punches that would fell an ox—why their training differs from that of any other contest—how the knockout blows are delivered—these and a dozen other secrets of the world's most exacting sport will be revealed in an article which you will find almost as entertaining as the big fight itself.

Here Are Correct Answers To Questions on Page 60

1. This was the national game of the Aztecs and of some of the previous peoples of Mexico. Nearly 1,000 years ago these people had built great stone ball-courts, with curved stone rings at each side, through which the ball had to be put. One such survives at Chichen Itza, in Yucatan. The game has survived among the natives in the mountains of western Mexico. It is called "hip ball," because the ball is commonly driven by a blow of the hip.

2. Mainly in the island of Trinidad. The plants from which the genuine bitters are prepared are natives of this island.

3. Nowadays varieties of this red pepper are raised in many parts of the world, but originally it came almost entirely from Cayenne, now called French Guiana, on the northeastern coast of South America.

4. A good deal of radium is now produced from ores obtained in Colorado, but the original source, and still one of the largest, is the mineral named pitchblende, mined in the Joachimsthal, a valley in Bohemia.

5. While the Gulf Stream is flowing eastwardly across the Atlantic Ocean to warm England and France, a stream of ice-cold water from the polar regions is descending west of Greenland and bathing the coast of Labrador. Accordingly, Labrador, while in the same latitude as London, is much colder.

6. In the most inaccessible part of southeastern Utah are great natural bridges, vast stone arches hollowed out of the sandstone of the region by the action of water and wind. The largest was well known to the Indians as "The Rainbow Turned to Stone."

7. Considering both height and the amount of water that falls, this distinction must go to the famous Victoria Falls on the Zambesi River, in Rhodesia, South Africa. These falls are some 400 feet high, more than twice as high as Niagara. The river is over half a mile wide where it falls into the gorge.

8. The islands of Japan. Japan also possesses fifty-one active volcanoes, more than any other country in the world.

9. In Australia there lives a lizard called the hatteria. It is only a few inches long, but if you saw an enlarged photograph of one of them, you might mistake it for a reconstruction of one of the dinosaurs fifteen or twenty feet long that lived in earlier geologic times.

10. The Dead Sea is believed to answer this description. This sea has no outlet. Its water is almost saturated with salt. No fish can live in it.

11. Over a great part of the area of the southern states a bird's-eye view would show you thousands of raw gashes cut into the valley slopes and the hillsides by soil wash, or erosion. The cutting of the trees left the soil exposed so that rain could wash it away. Happily, steps now are being taken to remedy this condition.

12. This famous area of swamp land is in southeastern Virginia, south of the city of Norfolk. At a few places in it small farms have been reclaimed.

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WANTED—Live foreman of mechanic or clerk in every factory in the United States to act as subscription representative for the most popular magazine in the world. Address Manager of [illegible], Popular Science Monthly, 250 Fourth Ave., New York.

MEN— experience unnecessary; travel; make secret investigations, reports; salaries; expenses. Write American Foreign Detective Inst., [illegible] St. Louis, Mo.

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Copy this bathing girl and send us your drawing — perhaps you'll win first prize. This contest is for amateurs only, so do not hesitate to enter, even if you haven't had much practice.

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2. Use only pencil or pen.

3. No drawings will be returned.

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5. All drawings must be received in Minneapolis by July 10th, 1928. Prizes will be awarded for drawings best in proportion and neatness by Faculty members of the Federal Schools, Inc. All contestants will be notified of the prize winners. Make your drawing of the girl now and send it to the address given in this ad.

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AGENTS: [illegible] New Orleans, Louisiana.

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IMPORTANT: Advertisers. Are you getting big profits from your ad [illegible] Quick Action Advertising [illegible] Popular Science Monthly [illegible] Popular Science Monthly, 250 Fourth Ave., New York.

Dick Byrd—Adventurer

(Continued from page 30)

ice to see if it were practical to land there in case of trouble. But they saw only broken, jagged ice cakes. Byrd knew then that a forced landing must mean sure death to himself and his men.

They climbed to 5,000 feet. In an hour they were over the Ellesmere Land ice cap. Below them spread a desolate wilderness of steel-blue glacial ice with black jagged mountain peaks thrusting through.

In 1914 the writer crossed this same land by sledge. Cold, deep snow, precipitous cliffs, and constant wind made it almost impassable. Had Byrd been forced down, even to a safe landing, he might never have come out alive. Probably no more hazardous flying ever had been done.

Suddenly the oil gage on Byrd's plane began to mount. This meant stoppage on the line.

BYRD glanced inquiringly at Bennett. Both craned their necks and looked over the side. No, there was no chance to land a crevassed glacier just below and a fiord crammed with rough ice beyond.

Bennett met the crisis by climbing out on the wing in the heart of bitterly cold air and unloosening the top of the oil tank. He was badly frost-bitten, but saved the lives of both by his brave act.

Byrd would not turn back. Once beyond the mountains he determined to lay a cache of oil and food on the far side of Ellesmere Land. Risking everything, he made a perilous landing among the floes of Cannon Fiord. Due to wind and reefs he dared not taxi to the beach. He and Bennett clambered overboard and in the icy water waded ashore with the supplies, fifty gallons of fuel, fifty pounds of pemmican, a little tea and biscuit, enough to save a party in emergency later on.

Over 6,000 miles in all Byrd and his men flew in the short fifteen days of Arctic summer left them. But in vain. Howling gales, blinding snow and heavy fog or clouds drove them back every time. The *Peary* steamed out of Etah for New York on September 5, just in time to escape early Arctic winter.

"Again I had failed," says Dick Byrd. "But again I had the consolation of knowing I had made progress. I had proved that the airplane is a practical vehicle in the Far North."

Also he had found Bennett.

Together they plotted on their return south. "Will you go to the Pole with me?" Dick asked him.

"SURE," said Bennett.

Now came the same story all over again: doubting admirals, opinionated politicians, unapproachable millionaires, prying cranks, fawning camp-followers.

I had breakfast with Dick Byrd and Floyd Bennett in the Hotel Astor, New York, in late March, 1928. They were like a splendid pair of pirates, stripped to the waist for attack against an incredibly more powerful enemy. The enemy in this case was public indifference.

"We may get a ship," said Dick. "We may get some money."

He paused, Bennett glanced up from his ham and eggs and grinned.

"But he's going to fly to the pole," he put in.

Floyd was right.

First, though, it was necessary for both Byrd and Bennett to get permission to go north again. Mediocre success of the Greenland expedition had left the Navy Department cool towards further Arctic flying. But finally both men managed to get leave.

Next came an involved dispute as to where the expedition should base once it reached the Polar Sea.

There were three distinct proposals by scientists and geographical societies. The first was that Byrd hop off (Continued on page 142)

Dick Byrd—Adventurer

(Continued from page 121)

from Point Barrow, Alaska. An equally ardent group favored Etah, North Greenland. But through all the heat of argument Dick Byrd kept his head and finally chose Spitzbergen, north of Europe. He made his decision and stuck by it.

"Spitzbergen is nearest the pole," he said in a public announcement of his plans. "The Gulf Stream makes it easily accessible by ship. There is good take-off ground for a plane using skids. And there are radio connections."

In the end his dictum was accepted.

Meanwhile Byrd faced a far more vital problem. He had only about $15,000 in the bank. He needed $150,000!

The first man he tackled was Edsel Ford, who had helped on the Greenland expedition.

"Frankly, Mr. Ford," said Byrd, laying his cards on the table, "there are no less than five polar expeditions under way right now. Moreover, I may have to use a Fokker plane."

The Ford Company already had started making their own planes, but

"Certainly I will help you," was Ford's prompt reply. "I believe your expedition will do a lot to increase popular interest in aviation in America."

Not only did Mr. Ford promptly give a generous sum, but he wrote another such sum and asked him to help the young naval officer.

But Arctic work is terribly expensive. Even with all the help he received, Byrd left the United States in 1926 more than $30,000 in debt.

"Bennett and I were not half so worried about breaking our necks on the Polar ice," he later told me, "as we were about smashing our plane on the take-off. Had we done so the expedition would have ended then and there. It would have taken me years to pay my debts."

Such is the new style hardship of modern exploration.

TO SECURE plane and ship were the next two problems. The first was solved by an arrangement with the Fokker Company for a fairly old plane that had already flown more than 20,000 miles. It was a big three-engined machine with a wing spread of sixty-three feet three inches and two 100-gallon gasoline tanks.

The second burden of anxiety was lifted when the Shipping Board turned a good vessel, the *Chantier*, over to the expedition for a gross sum of $1. However, in the last mad weeks of preparation Byrd found himself confronted with nearly $10,000 worth of necessary repairs before the ship could go to sea.

His final bit of misery came with the selection of his personnel. He had no money to pay his men and no home to offer them, save a hard trip with plenty of work at the end. It speaks well for the youth of America that there were more than 5,000 volunteers, from which the leader had no trouble picking about fifty good seamen and engineers.

On April 3, 1926, the *Chantier* sailed from New York. On April 29th, she arrived at her destination, Spitzbergen.

Muffled in oilskins to keep out the driving snow, Dick Byrd stood braced against the little steamer's bridge rail as she picked her way among the jagged floes that choked the harbor.

"Shall we anchor?" came from the forecastle.

At this moment Captain Brennan, Master, stepped up to Byrd's side, and pointed toward the only dock where sulkily lay a small freighter refusing to give way to the American expedition, for the very good reason that her own Norwegian countryman was hurling north in his dirigible, the *Norge*, in hope of winning first honor in the great polar air race of 1926.

"We can't make her move, sir."

The words seemed to spell failure, for first honors count nearly all in this curious human striving to do big things.

"Very well, Brennan, anchor."

"But the plane, sir?"

"We'll take her in over the ice."

Captain Brennan was aghast at this suggestion. Even Norwegians ashore warned Byrd against so foolhardy an undertaking.

Yet the next morning a big raft was built of boats and timbers. Massive ice cakes were made to do their share. Byrd, as usual, seemed tireless.

Roald Amundsen dropped down out of the sky in his big airship. The waiting world, apprised by radio of the dramatic situation, sat on the edges of its collective chair and waited.

Through the drifting floes of the harbor the raft with her precious burden was rowed and pushed. The slightest variation in tide or wind would have swept the whole outfit to sea.

AFTER a heart breaking struggle through the bitter cold, the big plane finally rested on the fast shore ice. Just inshore a broad white plain sloped upward toward the snow-covered mountains. It was on this plain that Byrd planned to build a runway from which he could take off.

Despite the near-exhaustion of his men, he dared not call a halt in proceedings. With Amundsen there and almost ready to go, every minute counted.

At the last moment Dick fitted out material for a light sledge and put it in the plane. On this he and Bennett planned, if forced down, to put their provisions, rifle, ammunition, and spare clothes and drag it southward.

Finally all was ready. The plane stood poised at the head of the long white runway like a giant bird. The Norwegians and other local inhabitants came out for curious looks, wondering if the bold American flyer were going to succeed. The crew of the *Chantier* assembled, silent and tense. Byrd and his men knew that a crash would undoubtedly end the expedition. All his eggs were certainly in one basket.

The engines were started. Byrd and Bennett in their fur clothes got aboard. The plane started. Slowly she gathered speed. Then suddenly she tilted. There had been a bump or soft spot in the slide. With a thud she rounded up in a snowdrift. One of her skids was smashed to kindling wood.

AFTER a sleepless night of work Byrd and Bennett started again. This was May 8, 1926. In less than an hour he was winging his way over the Polar Sea.

As he sailed over the rough ice and saw the lanes of open water and ridges of enormous white blocks below him, he realized the chances he was taking.

But there was little time to worry. Both men took turns piloting. When Bennett was off he worked on the engines, inspected wings and body, poured and checked fuel, and handled the mechanical side of the flight.

Dick Byrd left the wheel only to devote his time to navigational work. Continually he took observations with his drift indicator through the trapdoor in the bottom of the fuselage. He marked his times with two chronometers, the errors of which he knew to an accuracy of one second.

Exposing himself to frostbite and snowblindness, from both of which he suffered severely, he took frequent sextant altitudes of the sun, in order to fix the plane's position on the chart. Each altitude put him on a "line of position" which he plotted accurately, bringing up the last "line" to cross it for a "fix."

Later this chart was examined by a board of scientists in Washington. (Continued on page 124)

Dick Byrd —Adventurer

and declared perfect evidence of Byrd's having reached the pole. (It was taken to Washington by the author.)

By the newly-invented sun compass the course was frequently checked. Altitude and speed readings were recorded for dead reckoning in case the weather became thick.

In the fleeting moments between these various duties Byrd scanned the horizon for new land, noted the condition of sea and sky, read barometer and thermometer, filled in the columns of his meteorological record. And during it all he found time to keep a hasty but comprehensive log of the historic flight.

ALL night long—but with the midnight sun always up—the *Josephine Ford* winged her way northward. At nine A.M., May 9, she circled the North Pole.

Luckily, the sky was clear. Below in every direction still spread the ice fields. It was the same sort of ice that Peary had reported at the pole. There were a few cracks through which dark patches of open water showed. There were large icebergs lodged in the field, and long lines of ridges thrown up by wind and tide.

At this point every direction was south. At the North Pole there is no east or west. At this point the day was six months long, the sun rising on March 21 and setting on September 21. All summer long the sun went round and round, going up for three months and then going down for three months. When it disappeared below the horizon it did not reappear again for six long months more.

The moon also did queer things. Every month the moon came, circled round and round up into the sky for about a week, and then circled down again for another week. For about two weeks in each month there was no moon. No more desolate place can be imagined than at the North Pole.

After flying in a wide circle several miles in diameter in order to leave no possible question about his having reached the pole, Byrd set his course back for Spitsbergen.

ANGUISHED hours now followed. One engine was leaking oil badly. Bennett motioned an inquiry whether they should land on the ice and try to fix it. But Byrd shook his head. A glance at the chaos below showed all too plainly that such an effort could only meet with disaster.

The wind began to freshen. Cloud shreds scudded across the sun. A gust struck the plane, tipped her. The precious sextant fell on the deck—the only sextant aboard—and broke its horizon glass, making it useless.

Things looked serious. Only the sun compass could be counted on to bring them back safely. And it was useless if the sun was obscured by clouds.

"The elements were surely smiling on us that day," wrote Dick afterwards, "two insignificant specks of mortality flying there over that great vast white area in a small plane, speechless and deaf from the motors, just a dot in the center of 10,000 miles of visible desolation."

Luck or Providence, as you will, saved the pair of brave men. Somehow the leaky engine kept running. Somehow the sun stayed out enough for a sight now and then with the compass.

Seven hours later white peaks came into view on the southern horizon. Before their numbed minds could grasp the joy of being back, Dick Byrd and Floyd Bennett stepped out of their plane and into the arms of their cheering shipmates.

Another stirring chapter next month will carry you with Dick Byrd along further paths of adventure—through his triumphant return home from the Polar flight, and on to the great hop across the Atlantic.

The Movie Maker

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"We liked your speech so well," he remarked gravely, "that we're going to ask for an encore."

He drew a document out of his pocket and handed it to the minister. Amazed, Don and Judy stared at the star and her leading man. But the professor seemed unsurprised. After a hasty polishing of his glasses, he beamed on the two young couples.

"A perfect double exposure," he announced in a husky, happy voice.

DON and Judy arrived in New York the day Carleton's picture was to have its premier. From their room on the eleventh floor of a large hotel in the center of the theatrical district they looked down on a huge electric sign across Broadway announcing the title of the new picture—SHACKLED LOVE.

"Now take me over to Fifth Avenue and turn me loose," commanded Judy, when they had hastily unpacked their bags. "At last I'm going to shop on *the* avenue!"

At Fifth Avenue and Forty-second Street Don left his wife with emphatic instructions to obey the red and green signals. Then Don hurried back to the theatrical district. Before leaving California he had wired ahead reserving a theater the last week in January and had sent the four weeks' guarantee—twenty thousand dollars. He had also set things in motion for the picture's publicity. The two weeks before opening night would be filled to the brim with details big and little, but if the picture "went over" at its premier, half a dozen big distributors would be ready the following morning with contracts for its world-wide release.

So busy was Don that he telephoned Judy to dine alone, and they were not ushered into their seats at the theater across from their hotel until "Shackled Love" had been on the screen ten minutes.

"What do you think of it?" asked Judy during intermission. They were almost alone in the theater, most of the audience jamming the lobby.

"Well," Don's voice was hesitant and kindly, "Carleton has certainly achieved some very fine pictorial effects."

"Yes, it is deadly." Judy smiled impishly at him. "That picture's not much more than a super-special travelog."

IT WAS nearly midnight when the two wandered along Broadway, arm in arm. Near Columbus Circle they paused before a brilliant store front, displaying printed invitations to "come in and photograph yourself: eight poses for a quarter."

"Let's see what it's all about." Don steered Judy in through the open door. "I've wanted to examine one of these machines ever since I read about the inventor—a Russian, I believe. He got a million flat for just a share in his machine."

Two lines of people stood beside each of the ten or twelve small booths that housed the automatic cameras. Don's quick glance, however, discovered a machine that was minus its waiting lines. Instead, a small knot of men clustered around a workman who, with the casing off the mechanism, was making some adjustment.

As the workman slid the casing back over the vital parts of the machine, a tall lank fellow in front of Don straightened up so suddenly that he knocked Don's hat to the floor. Scooping it up, he started to hand it back, a hasty apology on his lips. But the apology was never finished, for, with an exclamation of surprise, the tall thin man, brown as an Arab, thumped Don's shoulder.

"Brick Kennedy!" he exploded. "How in—"

"Why, it's Boso!" exclaimed Judy. She shook Boso's leathery fist in hearty welcome.

Speechless with laughter and surprise, Don adjusted his hat, then took his turn pumping the camera man's hand.

After a few excited questions and answers, Boso told them that he, too, had arrived in time to witness the premier of "Shackled Love."

"And ain't it gosh-awful!" he boomed. "Now—I'll tell you what's wrong—"

But seeing that they were the center of an amused and rapidly increasing audience, Don and Judy persuaded Boso to leave the crowded place. Arm in arm, Judy in the center, the three walked on to the open space of Columbus Circle. There they entered a white-tiled eating place and found a table well at the rear. And for two hours Boso entertained them with a vivid and racy account of his adventures. The crown of them all had taken place after his ransom had arrived and he had been set free. Then his Arabian hosts, grown quite fond of their involuntary guest, had staged a good bye celebration. A magnificent exhibition of horsemanship had been put on for Boso to photograph—and the costumes worn were those that had been scheduled to appear in "Shackled Love."

"AND how them sons of the desert can ride!" said Boso. "I shot the scene as near as I could so's it would join in with the rest of the action. I'm sure you can splice in a lot of the footage, Brick."

* * *

Outside the theater electric lights spelled out the name "DRUMS OF TIME." Within the crowded house lights on walls and high-domed ceiling dimmed to an orange glow and faded out, while the orchestra swung, full volume, into a martial air.

Just beyond the center row were five people whose leaping pulses throbbed to the rhythm of the music, though their feet were still. Credit lines flashed on and off the screen. Then the story began with a humorous bit between Jerry and another doughboy. A chuckle breezed through the audience. Judy sighed and settled back more comfortably.

"Now we're off," she whispered to Don.

A few moments later Margaret's face, serene and beautiful under her nurse's cap, looked out over the audience. Back in the row where the five sat, a slim figure in silver reached out and touched the hand of an elderly man at her left, while she answered the pressure of her husband's hand on her right. And as the graceful white-clad figure was reflected on the screen, so radiantly alive, each one of the five recalled a night five months before when that same figure had swayed on the brink of self destruction.

MARGARET easily dominated the picture with her beauty and finished acting, but when Mabel appeared on the screen a ripple of fresh interest ran through the audience. Here was a new type—a goddess girl! And the court that pays homage to motion picture royalty is always eager to cry: "The queen is dead! Long live the queen!"

The Alpine sequence in which Mabel was the chief character concluded the first half of the picture, and the glittering, perfumed throng pressed up the aisles and out into the lobby. The five sponsors of the picture followed more leisurely, Margaret nodding to acquaintances here and there. Where the aisle emptied its human stream into the overflowing lobby they paused. Ahead of them on the big curving staircase, pressed a few steps upward by her admirers, stood Mabel beside her proud father. Her cheeks flamed with excitement and she seemed slightly dazed but wholly happy.

"A discovery you made, my boy, a real discovery!"

Don looked at the (Continued on page 183)

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direction of the familiar voice and held out a hearty hand to Jacob Eckstein, who shook it solemnly

"And a fine picture. I congratulate everybody. And now, Kennedy," Eckstein made an ineffectual attempt to draw Don toward one corner, but they were wedged too tightly in the chattering mass, "and now, how about a little business talk? Popular Players is being reorganized and starting production again the first of February. How about bringing in your own unit and doing us some super-specials? And don't forget we want that little girl on the stairs—a real discovery, my boy!

Don glanced around at the others with a twinkle. Then he looked down again at Eckstein.

"MY UNIT, as you call it, is disbanding tonight," he replied. "Miss Moreland is retiring—" Eckstein looked at Margaret in surprise and she smiled, nodding affirmation—"at the height of her screen career. Her husband, Mr. Burke, helped us out only temporarily in this picture. He must devote all his time now to his oil interests." Eckstein turned respectful eyes in Jerry's direction. Don tucked Judy's hand under his arm as Eckstein glanced toward him again "And this young lady and I have formed a company, 'The Judon Corporation of Hollywood,' which respectfully solicits any business you may have in backgrounds, foreign or domestic. Professor Mahrlenburg, the gentleman at your left, is head of our technical department, and Bozo Biddle, who is tangled up somewhere in this mob, is in charge of our field work."

"Then I can't put any of you under contract?" asked Jacob Eckstein, visibly disappointed.

Don's eyes strayed to the goddess girl on the stairs just as she looked down at the group. Mabel caught his glance and waved cordially

"You might try Miss Rogers," he suggested to Eckstein.

"Introduce me!" commanded the little man peremptorily, trying to shove his way toward the stairs. Then he looked over his shoulder and asked Don confidentially, "How much d'you think should I offer her? Such a fine actress and a comer!"

Jerry's chuckle sounded in Don's ear as he paused. Then his eyes met Margaret's for a brief, significant instant.

"I think Miss Rogers might consider signing for a thousand a week," Don replied slowly, as though after deep consideration.

ECKSTEIN winced, then smiled eagerly as Mabel and her father pushed nearer them.

"Anyway," he remarked cheerfully "her father gives us lots of free publicity I bet."

During the prolonged intermission everyone connected with the picture received hearty congratulations. Margaret, especially, was the center of attention. Some stared at her with puzzled, curious glances even though they seemed sincere in their compliments, but Rita D'Arcy, always present at premiers, heavily jeweled and as insolent as ever, was the only one who dared voice the question in everyone's mind

"My *dear!*" she exclaimed in her shrill voice. "How did you ever manage to stage such a *comeback!* After your *last* picture, I thought it was the *morgue* for you!"

Margaret could feel Jerry's hand tighten on her arm in a reflex of rage, but she only laughed with real amusement and turned to give her hand to a real friend. On her other side, clad in a shining golden dress, her small sister-in-law stamped an angry, gold-shod foot.

"Cat," Judy whispered violently "Now I know you're a success, Margaret Rita's just eaten up with envy!"

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The Movie Maker

(Continued from page 180)

But Margaret, the faint pink of her cheeks slightly deeper, only smiled again.

Intermission was over at last and with much rustling the audience settled down for part two of "Drums of Time."

"Now comes the real test," Don whispered to Judy.

But the picture held them with growing intensity as thrub multiplied. And when the airplane was shown flying low over the small company of soldiers, while a machine gun rat-a-tat-tat from the noise-maker off-stage added grim reality, many of the audience gasped and huddled down in their seats with instinctive fear. From then on the actors climbed from one thrill to another until, in the ghastly dawn on no man's land, the huge prehistoric beasts—representing the fears and hatreds not yet outgrown by civilization—overshadowed the dying soldiers and took over the awful combat.

FINALLY only one beast was left, the monster dinosaur, blood dripping from its horrible mouth. And in the nightmare of his sick illusion, Jerry staggered up from the field and fled before the monster. On the screen it looked too terrifying to be real and yet too real not to be believed. But it had been a rather simple double exposure, though instead of half the camera being masked, only the lower quarter of it on one side had at first been covered, so the huge creature appeared actually to hang over Jerry in all its terrifying proportions. Then Jerry turned and faced his fear—and it began to shrink. And as Jerry thrust his bayonet at the dinosaur, it dwindled even more. At last, rousing to consciousness as dawn broke over the battlefield and a rescue party came toward the spot where he lay, Jerry found that he had speared a small lizard on the end of his bayonet.

As the audience settled back with a sigh of relief, Judy clutched Don's arm.

"We've got 'em—we've got 'em!" she exulted in a whisper.

"Wait for the finish!" he murmured tensely, as excited as she.

Quickly the sequence in the hospital was shown, but the final close-up of Margaret and Jerry, instead of concluding the picture, faded out into the battleground, grass grown for ten years and blossoming with the flowers of war—small white crosses stretching away into the distance as far as eye could reach. But this scene darkened almost immediately into the terrible expanse of no man's land with its waiting dead.

At that point the orchestra grew silent and all over the house could be heard little quick-caught breaths. And then—three bugle notes, clear and sweet.

SUDDENLY, above the dark and motionless battlefield, a streak of light appeared in the dull sky. As the light grew stronger and curved down to touch the earth at the horizon, soldiers were dimly seen marching along the line of light into the rosy sun. The orchestra began softly to play Onward, Christian Soldiers. The spreading light touched the dead on both sides of the field—allies and enemies. Slowly, ephemerally slipping out of the dewy-wet and useless bodies, the soldiers rose. And it seemed that on the very surge of the mighty hymn now rolling triumphantly through the auditorium, they were borne aloft, marching, marching to meet their fellows in the sky—brothers and enemies, comrades all.

No need to wonder if the picture was a success when the screen grew dark and the lights went up. Caught into the spirit of the thing in spite of themselves, the audience, humming and beating time as they pressed slowly up the crowded aisles, shamelessly dried and powdered moist eyes and smiling faces, while the orchestra thundered out that magnificent marching hymn.

* * *

"And this one says—" Judy rattled her newspaper to attract the attention of the others. Seated around the parlor of their hotel suite, the four other owners of the big picture glanced up reluctantly from their individual newspapers. On a little table in the center of the group their breakfast was neglected while they devoured the only news of the day—the critics' report.

"This one says—it's that big woman critic, Don, the one who's coming to interview you this afternoon—" explained Judy importantly. "She says: 'I venture the prediction that "Drums of Time" will still be reverberating on Broadway when the tenth anniversary of Armistice Day has come and gone.'

"Oh, that reminds me of something I've been wanting to ask you to explain, Don," Margaret interrupted. "How did you get that effect of the long armies marching in the clouds. You didn't do it all by double exposure, did you?"

"Double printing for the sprits rising from the dead and marching skyward," Don replied. "And that part was joined by double exposure to the armies in the sky. All those distant regiments in the clouds were simply cardboard cut-outs glued to long rollers."

"BUT how did they merge together and then disappear in the sun's rays?"

"We pasted the rollers at irregular heights in the cloud scenery and pulled them by strings below the camera angle. When they converged near the sun, the advancing lines of each regiment simply folded up and rolled downward as new ones came up behind."

"Now listen to this critic," commanded Jerry, rustling his paper.

Finally they were willing to devote a little time to food, and when all had drawn around the small table Judy poured the coffee, kept hot in the small portable warming oven.

"Remember our first meal together in Margaret's kitchen?" Jerry looked meditatively around at the others. "A midnight supper—that was when we laid the plans for our picture."

"And now we're celebrating with a noonday breakfast!" Judy smiled brightly at her husband. "And, speaking of food—Don, what's the recipe for a successful picture?"

"Before I can answer that," he responded, "somebody tell me why it is that people go to the movies?"

"To get—or at least to see others get—the things they want most in life and perhaps are missing." Margaret laid her hand on Jerry's arm as though she, at least, had found what she wanted.

WITH a responsive glance at his wife, Jerry leaned forward and spoke energetically.

"Most people are so tied down to the routine of daily work that they aren't half alive," he declared. "They want red-blooded life—action—drama—on the screen."

"And none of us laugh enough," added the professor. "That's why we need the relief of comedy in the movies."

"Now it's your turn, Judy." Don looked at her expectantly.

"No movie gets my vote unless it has plenty of heart interest," she announced firmly.

"That's the third ingredient," Don decided thoughtfully, "and I guess it's safe to say that any picture with the three L's will be a success. Drama or action—that's life, comedy relief—laughter, heart interest—love. A combination that can't fail, on the screen or off—life, laughter, and love. And we've got them all!"

THE END

New Wealth from Magic Sand

(Continued from page 46)

up and dried, becomes a clear, granular material looking exactly like ordinary washed sand. But by the time that this method was worked out, the war was over, and silica gel masks never were produced in quantities."

But the adoption of silica gel by the commercial world has not been slow. Recently a freight car full of frozen fish made a ten-day trip from New England to Texas, kept frozen without ice by a silica gel refrigerator.

Such refrigerators, which are being placed on the market for homes, soda fountains, ice cream trucks, and the like, are extremely simple in operation. Liquid sulphur dioxide, a refrigerant, is evaporated from a chamber in the space to be cooled, and is at once adsorbed through a pipe by silica gel placed in steel tubes. The evaporation lowers the temperature. At intervals the gel is heated, and the heat drives the sulphur dioxide out of the gel pores into a condenser, which returns it to the cooling chamber to start another evaporation cycle.

In addition, silica gel is put to innumerable uses in manufacturing processes.

Already $4,000,000 has been spent on research work in developing its applications.

Mountain Carved into a Monument

[redacted]

his memorial to Gen. U. S. Grant in San Diego, Calif., took up the work. It was Lukeman's head of Lee, wrought in different proportions from that of Borglum, that was unveiled at the recent ceremonies. The sculpturings of Borglum had to be blasted out to obviate interference with the new designs.

The chisel of the sculptor is a battery of chattering pneumatic drills.

Borglum tried the usual known methods of enlarging a sketched design to fit the proportions of the mountain. But he found that no facilities that he might invent for creeping safely over the surface of the monolith would be adequate, either as to mechanics or art. Finally he decided to devise a huge machine to throw an image of the design on the face of the mountain. He would make the surface to be sculptured one immense photograph plate, and then develop it as he would a negative.

THE first workmen had to make a "foothold" in the granite façade that would serve as a base for subsequent operations and for the carving of the sculpture groups. They went over the side of the cliff in leather chairs at the ends of steel cables so that they might have use of both hands. They drilled holes in the rock in two parallel lines, four feet apart. Bolts were sulphured into these holes, and two-by-four timbers fixed to the bolts. Steps thus were made, by which the drillers could go back and forth from the top without the aid of the hoisting machinery.

Now workmen were lowered down to drench the cliff with barrels of nitrate of silver. The pictured design was thrown on the "plate" by a specially made projector, lighted with high-power lamps. Borglum used this method for "locating" the great central groups of his design. In detail work he made clay models of the entire frieze, divided them into sections, and made photographs of these. Then at night the photographs were flashed in black and white on the great granite "screen," and workmen traced the outlines with paint. Other workmen next morning etched out the design with their drills.

One to Thirty-one

(Continued from page 29)

and leaders. If the girls of Broadway and Hollywood Boulevard wear flesh-colored stockings, so do the girls of Wichita and Kokomo. And style is but one instance of the general tendency of women to follow established customs and knowledge. But the man is "from Missouri." What exists must stand or fall by the tests of reason or research. To say a thing can't be done, is to challenge him to do it, even at the expense of being called a fool. The "fools" who gave us the steam engine, automobile, airplane, radio, and much of our enlarged knowledge of the universe were masculine. Men have persistently upset existing orders.

"BUT," protests the feminine chorus, "women never have had a chance to display their ability. They have been so busy feeding grown-up geniuses and rearing little geniuses, that they have not had time nor opportunity to exercise their own originality. Circumstances have held them down."

There is truth in that argument, but not enough. For instance, in fields where women have had the greatest training and opportunity to display genius—such as dressmaking, millinery, interior decorating, and child psychology—it is the men who are the recognized specialists and leaders.

Again, the men who have attained fame as geniuses rarely have had an easy time of it. Look at the great French landscape painter Corot. A traveling cloth salesman, he starved and painted for thirty years before he could sell one picture! Beethoven, the composer, was too poor to afford a dress suit and had to conduct his great Ninth Symphony in a bright green coat. Look at Theodore Roosevelt, a sickly weakling, fighting and becoming a hard-fisted leader of a nation. Or Demosthenes, a stuttering boy, shaving half his head in order not to be tempted to leave his studies for the pleasures of society, overcoming natural impediments and becoming the world's greatest orator. Or Dr. Gorgas, who stamped out yellow fever in the tropics, fighting for a medical education in Bellevue Medical College with his trousers patched with pieces of an old felt hat! The list of male geniuses who "never had a chance" might be extended almost indefinitely.

But of late another argument has been advanced. It is that women are handicapped from the start by being always made to feel inferior. "It is frequently overlooked," says Dr. Alfred Adler, famous Viennese student of personal traits, "that a girl comes into the world with a prejudice sounding in her ears which is designed only to rob her of her belief in her own value, to shatter her self-confidence and destroy her hope of ever doing anything worth while. If a girl sees again and again how women are given servile rôles to play, it is not so hard to understand how she loses courage, and sinks back from a solution of life's problems."

But this again cannot explain the comparative shortage of feminine genius. Almost everybody suffers this feeling of inferiority, more or less. Having it is not what matters, it is what you do with it. Some of the world's greatest deeds have been wrought by men who felt a secret sense of mental or physical shortage. If Napoleon had been a foot taller, the history of Europe might have been wholly different. The little Corsican's appetite for power undoubtedly sprang from the feeling of inferiority which an undersized body gave him. The late Dr. Charles P. Steinmetz might never have become a great electrical and mathematical genius, had not the sense of physical deformity spurred him to become a mental giant.

"The world is full of men of vast achievements," says Dr. James H. Leuba, Professor of Psychology at Bryn Mawr, "who owe their success to a surpassing energy actuating a mediocre brain. Not their intellectual talents, but their ceaseless use of them is their distinction."

And so, when we get to the root of the question, we find the fundamental reason for the masculine monopoly of genius. It is not that men have more natural intelligence than women. It is that man fights better and harder with what he has.

This undoubtedly is because man has greater reserves of energy. If you ask a biologist for an explanation, he will tell you the secret lies in those little drug stores called endocrine glands, which work chemical miracles in the body, and which are believed to have much to do with the vital differences between the sexes. In man, they release powerful chemicals into the blood, making him larger of frame, stronger of muscle, and more aggressive. If certain of these drug stores in the male quits business, or is removed, some of his distinctly masculine characteristics disappear, he becomes fat and submissive. When investigators, experimenting with poultry, have transferred some of the glands from rooster to hen, the latter has become the aggressive possessor of a comb, wattles, and a raucous baritone voice!

When we think of Edison laboring in his laboratory for sixteen hours a day, or of Paderewski with his twelve hours of piano practice daily, we begin to get an idea of what the energy output of true genius means.

But, significantly, while man's chemical make-up pushes him to greater heights, it also produces more insanity. Men scatter up and down the ladder of mentality. Women stay near the middle, avoiding the extremes at both ends. As a rule, women are more alike in intellect than are men.

Quite evidently, then, Nature does not intend many women to be geniuses. Woman is needed as Nature's chief agent of reproduction; therefore she must remain truer to type than man—she cannot be allowed to vary far from the average. And so, to the mothers of the race is left a rôle fully as important as that of the men of higher attainments. Upon woman the world relies to consolidate the gains won by the more foolhardy and energetic sex. She weaves his newly achieved knowledge and discoveries into the fabric of common life, binding the new to the old in a pattern strong and durable. Upon her, too, falls the burden of bringing new geniuses into the world.

THERE is one consideration, however, which cannot be overlooked. It is that the term genius, as commonly used, applies only to those dramatic forms of achievement which stand out and strike the eye. Isn't it reasonable to suppose that the number of women who have become great in sympathy, mother-love, and home-making is fully as large as the number of men who have become great inventors, painters, and mathematicians?

Women of all time have been driven by a passion to excel as sweethearts, mothers, and home-makers. And who can deny their greatness here? Even women included with men on the list of geniuses have never lost this desire. Madame Curie, touring through the United States after the war, often would turn to her American companion as the train passed some modest cottage, and exclaim:

"I have always hoped to have a little home like that some day!"

So we come to the reason that seems most important of all. Women do not count large among the geniuses because they do not want to be geniuses. They want to be women.

The Thirty-One Geniuses

Here are the names of the thirty-one geniuses whose pictures appear on page 89

1. Michael Faraday, English chemist and physicist, discoverer of magneto-electric induction.
2. James Abbott McNeill Whistler, famous American painter and etcher.
3. Guglielmo Marconi, Italian electrical engineer, inventor of wireless telegraphy.
4. Edgar Allan Poe, American poet and romancer.
5. Alexis Carrel, French-American surgeon and biologist, a leader in modern surgery.
6. Alexander Hamilton, great American statesman and financier; first Secretary of the Treasury
7. Prince Bismarck, German empire builder and dictator
8. Robert E. Lee, military genius, commander of Confederate Armies in the Civil War
9. Eli Whitney, American inventor of the cotton gin and originator of mass production in industry
10. Wilhelm Richard Wagner, German musical composer and poet
11. Henry Ford, American automobile inventor and manufacturer
12. Ludwig van Beethoven, German musician, genius and composer
13. Thomas Jefferson, father of American democracy, third President of the United States.
14. Napoleon Bonaparte, French military genius and empire builder.
15. George Washington, builder of a nation; first President of the United States.
16. Woodrow Wilson, President of the United States during the World War, distinguished educator and historian.
17. Herbert Spencer, English philosopher and scientist, founder of modern evolutionary philosophy
18. Abraham Lincoln, great emancipator, President of the United States during the Civil War
19. Samuel F. B. Morse, American artist and inventor of the telegraph
20. Daniel Webster, American orator and statesman
21. Charles Darwin, British naturalist, discoverer of evolution
22. Benjamin Franklin, American statesman, inventor, and author
23. Samuel L. Clemens (Mark Twain), American author and humorist
24. Thomas A. Edison, American inventor and electrician genius.
25. Auguste Rodin, French sculptor and painter
26. Louis Pasteur, French chemist and bacteriologist, discoverer of antitoxins.
27. Horace Greeley, distinguished American journalist.
28. Albert Abraham Michelson, American physicist, famous for his measurements of the speed of light
29. Wilbur Wright, co-inventor of the airplane.
30. Ulysses S. Grant, commander of the Union Armies during the Civil War, and President of the United States.
31. Alexander Graham Bell, American scientist, inventor of the telephone.

If you were asked to select the thirty-one greatest modern masculine geniuses, would your list agree with this? What names would you omit, and what ones would you substitute? POPULAR SCIENCE MONTHLY will be glad to have your opinion. Address The Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City

A definite program for getting ahead financially will be found on page four of this issue.

"Hunky"

(Continued from page 80)

face and jerked over the digging motor switch. The rumble of the bucket-line died away as Tim cut out the pumps, the stacker belt, and "grizzly" motors. He hurried on deck.

The dredger was swinging slightly to starboard. The main current of the river, even in the last two hours, had shifted perceptibly closer to the boat. The bulwark which had been thrown up by the stacker was rapidly washing away. O'Leary could see that the boat was in danger. It was imperative that they get out another line at once.

O'Leary swung around to Hunky. The Irishman wasn't grinning now. "You git ashore as fast as ever ye can. Call Purcell an' Lancaster an' have 'em help ye git another line out here."

HUNKY needed no urging. He dove into the scow and pulled out into the river. Across the stream he made out the lights of the camp, gleaming faintly through the pouring rain. The old blunt-nosed scow cut the water like a racing shell under the impetus of his powerful muscles.

He pulled up to the pier, made a hasty hitch around a pile, and leaped ashore. Five minutes later he had routed Purcell and Lancaster out of bed, and the three of them were hauling a spare cable out of the storehouse and down to the river. One end was made fast to a "deadman." The remainder of the cable was coiled in the stern of the scow.

"Where's the other boat?" Lancaster demanded.

"The night shift," Hunky said. "They must a' landed way downstream. They couldn't row against this current."

"Then how are you going to row against it?"

"I'll do it, sir."

The super turned to Purcell. "You stay on the bank, Bob. I'll go out with Hunky." They got into the boat. "Want me to take an oar?"

"I think I can handle 'em better alone," Hunky answered breathlessly.

"It'll be a tough pull, with the weight of the cable dragging you back."

"I can make it." Hunky took a deep breath. "I gotta make it."

Lancaster called over his shoulder as they shoved off into the stream. "Bob, you'd better see if you can round up the other scow and haul it up here. There's no telling what will happen before the night's over, with the river rising like it is. We may need another boat."

HUNKY bent his back to the oars. The bank slipped away from them. Lancaster, in the stern, paid out the cable, and marveled at the sheer brute strength of the man at the oars. Before they were halfway over to the dredger Hunky's labored breath was whistling through his teeth.

"Want me to spell you?" Lancaster asked.

"No. Take too long—to make the shift—lose too much—ground. I'll make it. Gotta—make it."

The oars bent. The lights of the dredger drew closer inch by inch. Lancaster found it hard to believe that one man could stand the strain of such violent physical exertion. But Hunky stood it, and at last the scow swung against the dredger.

Lancaster leaped out onto the deck. "Pass me the painter!" he cried.

Hunky's mind, however, was on the cable. He grasped it and stood erect. Lancaster caught the end of the cable. O'Leary caught hold of it, too. They were just in time.

The current caught the boat, swung it out from under Hunky. The oiler fell into the river with a muffled cry. But he clung to the cable, and Lancaster and O'Leary dragged him onto the deck, while (Continued on page 131)

"Hunky"

(Continued from page 130)

the scow drifted out of sight in the darkness.

"That was a fool thing to do," Lancaster growled. "Why didn't you hand me the painter?"

"It was in the bow." Hunky pawed the muddy water out of his eyes. "I couldn't reach it. I thought I could hold her. She went right out—from under my feet."

"Naturally. And now we're stuck here until Purcell gets that other boat and tumbles to the fact that we can't get ashore. Well, no matter. We got the cable aboard. That's the main thing."

They got the cable on the windlass and took in the slack. Lancaster found a flashlight in the winchroom and went up forward. Hunky and O'Leary followed him.

The super cursed softly. "No more work tonight. The channel's shifting. See those eddies out there? See how they're moving in toward the bow? Lucky that someone broke. If it hadn't, you'd probably have gone on working until the boat piled up on some bar down the river."

O'LEARY was very sheepish. "Sure, an' I never thought it was that bad, Mr. Lancaster."

"Don't you ever think it isn't," Lancaster snapped. "We've got to get this boat inshore before the current works over here. Another half hour of this and we'd lose her."

"Yes, sir."

"Hoist your spuds and your digging ladder and we'll swing her in as far as we can. And make it snappy, O'Leary. There's not a minute to lose."

"Yes, sir."

Tim's cheeks were burning as he leaped toward the winchroom.

"You—you think there's any danger, Mr. Lancaster?" Hunky asked hesitantly.

"Certainly there's danger," the superintendent answered angrily. "There's always danger in a storm like this when we're working so close to the main channel. Why? Afraid you'll have to swim for it?"

"No, sir. I ain't afraid o' the river. I can swim it if I have to. I was thinkin' about—our dredger."

Lancaster chuckled in spite of himself. He laid a friendly hand on Hunky's shoulder. "Don't you worry, Hunky. We'll save the old dredger."

HUNKY rubbed his chin with his clenched fist. "I'd hate to lose her, Mr. Lancaster. I think a lot of her. She's a right fine ol' boat."

Lancaster started to speak and then broke off as the deck was plunged into darkness. He cursed sharply. "Now what the devil?"

Both men stared across the river. The lights of the camp were faintly discernible.

"Couldn't have been the power plant," the superintendent muttered.

"Guess Tim must 'a' blew a fuse," Hunky said. "Gave her the juice too fast."

Lancaster switched on his flashlight and strode toward the winchroom. Hunky stumbled along behind him. They found O'Leary cursing and pawing through the tool boxes.

"Main fuse went out on me," the winchman said. "An' there ain't another on the boat." He stood up, staring helplessly at Lancaster.

The superintendent glowered. "What kind of a dredger are you running here, O'Leary? Haven't you got brains enough to have spare fuses on hand?"

"It ain't my job to have spare fuses on hand," Tim cried. "That's up to the dredgemaster."

Lancaster said nothing for a moment. The sinister moan of the river had grown louder.

"A nice mess we're in. The superintendent's voice was" (Continued on page 132)

A definite program for getting ahead financially will be found on page four of this issue.

"Hunky"

(Continued from page 131)

coldly quiet. "In another half hour we'll be getting the full sweep of that current. We have no power to move the boat. You know what will happen. The deadmen on the right bank will pull out. And we'll all take a nice fast ride down the river. All for lack of a fuse.

O'Leary glowered at Hunky. "Or," he said with deep sarcasm, "for lack of a boat to go ashore an' git one."

Hunky flinched. His shoulders sagged. He stared pleadingly at Lancaster. Then his shoulders suddenly came erect.

"I'll get you a fuse, sir."

"Where?" Lancaster demanded.

"I'll swim ashore."

"You're out of your head, man."

"No, I ain't. I've swum that river lots o' times. I can make it. I gotta make it."

"You're crazy!" the super snapped. "You wouldn't have a chance in that current."

HUNKY was jerking off his shoes and his oilskins.

"I won't allow this, Hunky," Lancaster cried. "I won't allow any man to throw his life away—"

Hunky was out of his clothes and leaping toward the side of the boat. "Keep yer flashlight on," he cried over his shoulder. "I gotta have somethin' to hit for when I start back."

Lancaster tried to catch his arm. Hunky twisted away, poised an instant on the deck, and then dove cleanly into the black, swirling water . . .

No one knows much about that struggle in the darkness. No one save Hunky, and he never talked about it. Old river men, knowing the San Juan, said afterward that it couldn't have been done. But there were witnesses. Lancaster and O'Leary saw him dive off the dredger. And Bob Purcell, returning from a fruitless search for the other scow, heard footsteps scrunching in the mud and saw a naked, dripping man run past him.

"Fuse!" Hunky shouted hoarsely.

Purcell broke into a run, caught up with the puffing oiler.

"You—Hunky! Where did you come from?" the dredgemaster cried, aghast.

"From boat—swum—lost now—O'Leary blew—main fuse—gotta get—nother fuse—boat s'n—danger."

So Hunky told his story while he ran, gasping and almost spent, toward the storehouse.

Purcell found another fuse, and turned to the naked man at his elbow.

"But you can't get it out!" he exclaimed. "I couldn't find the other scow. It must have got adrift. There's no boat."

"DON'T need a boat—I can swim—can't I?"

"You're crazy! You're almost dead now."

Hunky did not waste his breath in argument. He jerked a canvas sack off the floor and tore a long strip out of it. He snatched the fuse out of Purcell's hand, tied it to the strip of canvas, and knotted the latter about his neck. Then he dashed out of the storehouse, with the dredgemaster in hot pursuit.

Hunky started up the river, splashing through the mud and darkness and rain. Purcell followed with his flashlight and tried vainly to argue the oiler out of his crazy plan.

"Hunky, use your head! You won't have a chance of making the dredger. Her lights are out. You'd never see her in the darkness. You don't know these currents. They've all changed since the river rose. Don't be a fool!"

"Ain't a fool!" the big oiler puffed. "Gotta get that fuse out, ain't we? Gotta save the boat, ain't we? Lancaster said—she wouldn't last—half an hour. Gotta save her!"

¼ quarter of a mile above the dredger Hunky splashed into the river. Purcell followed him until the water was above his waist, pleaded with him, tried to hold him back.

But Hunky's wet body slipped out of the dredgemaster's clutching fingers, and plunged headlong into the oily black water. Purcell watched him out of sight. White arms flashing above the black water. A dark, glistening head moving slowly and relentlessly out into the current. An angry river fighting for its prey.

Hunky passed out of the range of Purcell's flashlight. And the dredgemaster plodded back to camp feeling oddly sick.

Lancaster and O'Leary waiting hopelessly on the deck of the dredger, heard a muffled cry in the darkness. Where had it come from? Somewhere near the dredger. But where?

Lancaster raised his voice in a shout. He swung his flashlight back and forth, cursed the feebleness of its beam.

THEN they saw him, vague and indistinct through the driving rain. He was struggling feebly. His arms were rising and falling with heartbreaking slowness.

"Hold the light!" the super cried.

O'Leary took it. Lancaster caught up a coil of rope, swung it twice around his head, and shot it out across the water. It dropped across Hunky's shoulder. And the oiler, with the last of his waning strength, caught it and looped it around his wrist.

Hunky was more dead than alive when they hauled him to the deck. There was something pitiful about him as he lay there gasping for breath, his great muscles trembling with exhaustion.

One hand moved feebly, motioning toward his neck. "Fuse," he muttered, and collapsed in an inert heap. An hour later, when the spuds and digging ladder had been raised and the dredger hauled to safety, he was still barely able to move.

And yet the following morning when Lancaster met him on the compound, he was again his old self. The storm had passed. The day was bright and crystal clear.

"How do you feel, Hunky?" the super asked.

Hunky blushed a little and rubbed at his chin with his knuckles. "Me? I feel fine, Mr. Lancaster."

"That's good. Do you know anything about dredgers, Hunky?"

"ME?" The big chest swelled with pride. "I know *all* about 'em."

"Think you could hold down the job of winchman?"

Hunky gasped and rubbed furiously at his chin. He wasn't quite able to speak.

"Well, what about it?" the super demanded. "O'Leary quit before I had a chance to fire him. Think you could hold down his job?"

Hunky fought for words. "Y-y-yessir!" he managed to gasp at last.

"Good. You'll take the graveyard tonight."

Lancaster walked off, very grave and businesslike. Some distance away he glanced back over his shoulder. Hunky was still rubbing at his chin and staring dazedly at the ground.

He's dredgemaster now. Dredgemaster of Number Four. And they say that the old boat is setting yardage records every month.

Prize Racing Turtles

TO POPULARIZE the world's slowest sport, turtle racing, in Hawaii, S. N. Castle recently sailed from San Francisco with thirty-two racers, one of which, he says, can sprint a hundred yards in four hours flat.

Breaking into Aviation

(Continued from page 44)

president of the Northern Airways, Inc., at Wausau, Wis., was still another who entered the business through the sales door.

The mechanical and engineering phases of aviation opened the way to careers for a number of flyers. Here, for instance, is the fascinating story told by John H. DeMott, who now manages a large general flying service at Palm Beach, Fla., including a flying school.

"During the war I was in the Air Service and got some flying instruction. After I was discharged I spent a year and a half with several of the largest aircraft manufacturing companies, working on design and drafting, then obtained a position as mechanic for a flying school. After a year of that I bought my own plane, reconditioned it myself, and soloed until I felt confident enough to carry passengers. I have kept at the flying end ever since."

A regular pilot on the Ford Airlines, Roy E. Keeler, likewise broke into the game as a mechanic.

"In 1917 I enlisted in the Air Service and received valuable experience in line work and servicing planes," he said. "My first commercial job was in 1920, setting up a ship and acting as mechanic on a barnstorming trip. On this work I learned to fly. My present position is the first steady year-round job I have had at a good salary in aviation."

Clyde C. Speecher, another former military pilot, got his start carrying pay rolls for oil companies at Tampico, Mexico—precarious but profitable at $500 a month.

MORE than one pilot created a job for himself by evolving an ingenious and brand-new idea. Jay M. Fetters, just out of the Army service, chased ducks from the rice fields of California.

A. M. Sampson, of the Bellevue Airport, Minnesota, began as an aviation pioneer in Alaska.

Similarly, five years' experience in railroad transportation work and two years in foreign trade served Grissom E. Haynes, of the Atlantic Aircraft Corporation, Hasbrouck Heights, N. J., when he quit Army flying.

"The first job I obtained," he said, "was in the Department of Commerce as an expert on foreign sales and markets for American aircraft products. The crying need is for men who have had business and executive experience and who will or have learned the aircraft manufacturing and operating technique. There are too many incapables or laymen at the top, while the majority of engineers and pilots are not qualified executives."

William P. MacCracken, Jr., Assistant Secretary of Commerce for Aeronautics, a trained military pilot, recalled that his first commercial air job consisted of trying a lawsuit involving an aviation contract for a former Air Service comrade.

About half of the flyers began their careers as free-lance pilots, barnstorming, carrying passengers, and engaging in exhibition and stunt flying. Thirty-two took jobs with aviation companies, eight organized their own [illegible] started flying schools, others began in miscellaneous ways: one started as a rum runner!

From such a variety of callings it would appear that a young pilot should not have difficulty in choosing.

Yet there are still more fascinating possibilities, as suggested by Robert S. Horsley, of Tampa, Fla.: "Airport equipment—meteorology—aerial lighting and signals—aerial radio communication—air travel tours—building a city around an airport."

"Have a definite purpose in view," he added. "Do your bit to keep the morale of the profession on a par with the enviable standing of our fighting flyers."

Flyers Who Rob Caterpillar Club

(Continued from page 41)

Schlossback was at the top of a loop, 4,000 feet up, when his safety belt slipped and he was pitched from his seat. Instinctively he grabbed for the braces—and there he clung while the plane flew on, upside down and pilotless! The ship turned over, and dove for 3,000 feet before Schlossback could crawl back in his seat, seize the controls, and straighten her out for a safe landing.

Skillful, cool-headed pilots have performed feats of daring that almost defy belief. There was the case of George (Daredevil) Ashby, an air circus stunter, whose specialty was hanging from a trapeze suspended from the wing of a plane. One day in Florida his body became numb in the cold upper air and he couldn't climb back to the wing. There he hung helpless. Lester Kirk jockeyed a second plane under the dangling body four times before he could get close enough, then he stood up in his cockpit, seized Ashby, and dragged him in to safety beside him.

JEANNE DURAND went up last winter with Dr. R. L. Ellis, of Minneapolis, to try for a new record for high parachute jumping. At 15,000 feet she went over the side, but her parachute caught on the wing, leaving her swinging, unable to free herself or to climb back. Crowds below watched in dread, but the pilot landed on one wheel and a wing tip and Miss Durand was ready to try the jump again the next day!

Lincoln Beachey was perhaps "the first of them all" in point of time and dare-devil experience. In his day, the aviator's chute was unknown. Once in 1913 his engine died several thousand feet up, and the plane started nose-diving earthward. Beachey tugged at the wires of his ungainly controls, righted the plane, and straightened it out. That was the first time that had ever happened to him! He called it the "Death Dive," deliberately tried it again, and added the stunt to his bag of tricks.

Neither the Army nor the Navy lays down hard and fast rules as to when a pilot shall jump or when he shall stick to his damaged or unmanageable plane. The men of the Caterpillar Club are, of course, as brave and respected a lot as their nonmember comrades who have refused to jump. It is generally considered, however, that the three occasions on which a pilot is justified in jumping are fire, collision, or a blinding fog or snow which cuts off view of the land.

The Navy has equipped some of its latest planes with an automatic "sprinkler" for use in a fire high in the air. But one of these recently failed to save Lieutenant Barnett T. Talbott, whose overheated motor burst into flames over Anacostia Field. Lieutenant Talbott took to his parachute and landed with his body severely burned.

IN ITS recently published "Annual Analysis of Aircraft Accidents for the Fiscal Year 1926–27," the Bureau of Aeronautics of the Navy Department has this to say to "All Aviation Units Ashore and Afloat."

"Bad judgment and inexperience were the two leading causes for errors in pilots during the past year. Every minute in the air is an opportunity for self-instruction. Stunting should be regularly engaged in, in order that pilots can improve their technique and acquaint themselves with the control of aircraft in unusual attitudes; observing, of course, the rules governing stunting, altitude, etc."

The Caterpillar Club, most exclusive of organizations, undoubtedly will gather new members each year. But the increasing skill of pilots and the successive improvements in aircraft construction will keep its roster from getting too large.

When You Plan to Build—

(Continued from page 68)

several ways, including the use of a steel girder, notching joists and resting them on strips so that tops of joists and girder are flush, and supporting joists with metal hangers at girder or wall. As far as the immediate purpose is concerned, it does not matter which method is followed.

The foundation wall of my house is low at the rear, about six inches above grade, and the sill is rotting. What can I do?

There are too many low-built houses like that, and a misguided sense of art is responsible for the newer ones. A drastic remedy costing several hundred dollars, forced on owners in some sections, is to have the house raised and the foundation built up to two feet or so above grade. Such a height prevents dampness and decay as well as forays of destructive insects. Instead of this it may be feasible to lower the outside grade at least a foot and tile-drain the near-by area. Protect the wall from roof water. Remove outside covering of siding or shingles to expose sill and paint or spray it with liquid creosote. The inside of the sill in the cellar may be similarly treated. Give two applications at some time apart so that the preservative soaks well into the wood. Hot creosote has more penetration than cold. Of course the sill should have time to dry out before it is painted or sprayed.

THE square wood bases of our porch columns are badly decayed. Is there any way to fix this without going to much expense?

Yes, if the bases rest on masonry. Dig out the decayed wood and touch up the underside of column with creosote. Make a base form of proper size. One side may be left open and tacked or wired in place after fitting. Fill the form with dense rich concrete and trowel to a hard surface. Cover with a cloth and keep it damp for a week. Leave form in place another week or two. When the concrete is well cured and dry it may be painted with linseed oil paint to match column.

DOES concrete for a cellar require waterproofing compounds?

About as much as a man with a raincoat needs an umbrella, according to Government authorities and the cement industry experts. One part Portland cement, two of sand, and four of gravel or stone is a standard recipe for a water-tight mixture. The ingredients must be first class and rightly sized. The coarse material should grade from an inch in diameter downward. After dry mixing add six to six and a half gallons of water per sack of cement. Each batch in a power machine should be mixed at least two minutes. After tamping well in place, keep the concrete damp for three weeks. Complete the placing in one day. If such concrete fails to hold out water the cause will be mechanical, such as cracks due to settlement of foundation or lack of reinforcement. However, it is common practice to insure the tightness of cellar walls by coating them outside with hot tar, sometimes above a plaster coat of rich cement. Inside plastering is also done with good results.

Is there any comprehensive book on American house architecture?

THE New York public library said a short time ago it did not know of such a book. There are a hundred books on this or that style or group, but nothing comprehensive. It appears that the layman must turn for summary enlightenment on architecture to trade publications, such as Russell F. Whitehead's *Good Houses*, published by Weyerhaeuser Forest Products. This work briefly describes and illustrates some two dozen styles.

What is the best hardwood flooring?

Maple is harder than oak. White oak is slightly superior to red. The prices are in the order given for the same grade and thickness.

If You Were Radio Czar

(Continued from page 84)

would be necessary anyhow to bring order out of the present situation, law or no law.

Of course, it is possible to accommodate almost any number of stations on the present wave bands by dividing time on the air. But it wouldn't pay any broadcasting station to maintain an expensive plant including competent announcers, musicians and so on, if the station were allowed to go on the air only a few hours a week.

Too many stations, too few wave lengths, unequal distribution of stations, too much power in some places and not enough in others—these are a few of the problems demanding solution before radio can give the greatest service to the largest number of people.

Suppose, for instance, that you were to be appointed the supreme authority over radio in the United States. What would you do? Which stations would you close for good? Which would you permit to increase power? How many stations would you have altogether? How would you have them divide time? Where should the most powerful stations be located?

POPULAR SCIENCE MONTHLY will award a first prize of $50, a second prize of $25, and a third prize of $10 for the three letters giving in the most concise form the best plan for the solution of the problems now facing radio broadcasting.

Anyone may compete for these prizes. Your letter may be of any length, but as conciseness is one of the points on which the officials will judge the letters, you will stand a better chance of winning if you use as few words as possible in presenting your plan. There are no restrictions of any kind. All letters must be received in the office of POPULAR SCIENCE MONTHLY by July 15, 1928. The judges will be the officials of the Popular Science Institute of Standards. In case of a tie the full amount of the prize will be paid to each of the tying contestants. Address your letters to: Radio Contest Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.

Telling Ocean Flyers When to Hop

(Continued from page 17)

prove invariable existence of winter storms.

"Look at this," I would say. "And this."

"They do look bad," she would admit with an effort at smiling. "But let's turn over a page, we may find more encouraging signs."

But she found none.

The season for trans-Atlantic flights by airplanes, at their present stage of development, is from May to September. The east-to-west flight is most hazardous because the prevailing winds are from west to east, and the days when the airman will have the wind at his back must be forecast with accuracy.

For that reason cooperative weather charting and forecasting should exist between American and European meteorological stations. Such a service would be an essential part of commercial air travel.

Meteorological stations in London, Paris, Germany, and Norway would collect their information and wireless it to us twice a day. We would make our forecasts after combining our observations with theirs.

Detailed information would be received twice daily from ships at sea, at Greenwich mean noon and Greenwich midnight.

We would be able even to chart the upper air to 2,000 or 3,000 feet, with information as to the character and movement of clouds.

To the flyers all glory. With airplanes constantly improving, no one can forecast what exploits lie before us. The weather, however, will always be a factor to determine between success and failure.

DON'T FOOL YOURSELF

Better to be safe than sorry when halitosis is involved.

Halitosis may get you discharged

Employers prefer fastidious people . . . halitoxics not wanted

MORE and more, employers insist on having about them people who are fastidious. Sooner or later, those with halitosis are "let out."

The true reason for discharge, however, is usually hidden under such phrases as "Inefficient," "You can do better elsewhere," "We need a more experienced person," etc.

Realize these facts about halitosis. That, due to modern habits, it is much more prevalent than is suspected. That it is a definite liability in friendships, affections and business. That you can have it and not know it.

The one means of being sure that you are free from it is to rinse the mouth systematically with Listerine. Every morning. Every night. And between times when necessary, especially before meeting others. Keep a bottle handy in home and office for this purpose.

Listerine ends halitosis instantly. Being antiseptic, it strikes at its commonest cause—fermentation in the oral cavity. Then, being a powerful deodorant, it destroys the odors themselves.

If you have any doubt of Listerine's powerful deodorant properties, make this test: Rub a slice of onion on your hand. Then apply Listerine clear. Immediately, every trace of onion odor is gone.

With these facts before you, make up your mind to keep yourself on the safe, polite and popular side by using Listerine.
Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

READ THE FACTS
⅓ had halitosis

68 hairdressers state that about every third woman, many of them from the wealthy classes, is halitoxic. Who should know better than they?

Have you tried the new Listerine Shaving Cream?

Cools your skin while you shave and keeps it cool afterward. An outstanding shaving cream in every respect.

LISTERINE

The safe antiseptic

H A V E A C A M E L

It's the favorite.

WHEN smoking is recognized as a pleasure, Camel has the call.